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WORLD HELICOPTER MARKET STUDY

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I. INTRODUCTION

For at least a decade following the end of World War II the USA was preeminent in the field of helicopter design, development and production, and world markets for both military and civil helicopters were dominated by the USA.

Over the past decade, however, this dominance has been steadily eroded by a determined effort by foreign manufacturers, European companies, in particular, to supply their own domestic markets and also to penetrate export markets, including the USA.

To assess the extent of the threat to the U.S. helicopter industry posed by these developments, this report first collates available data on U.S. and world markets for civil and military respectively. Data are presented in both graphic and tabular form and cover the past history of production and markets and, where forecasts are available, anticipated future trends. The data are discussed on an item-by-item basis and inferences are drawn in as much depth as appears to be justified.

The employment levels of the major manufacturers over a recent three-year period are compared to identify possible growth trends.

While it is difficult to account for the extent of market penetration by foreign competition in explicit terms, the role played by political and technological factors is considered in broad terms.

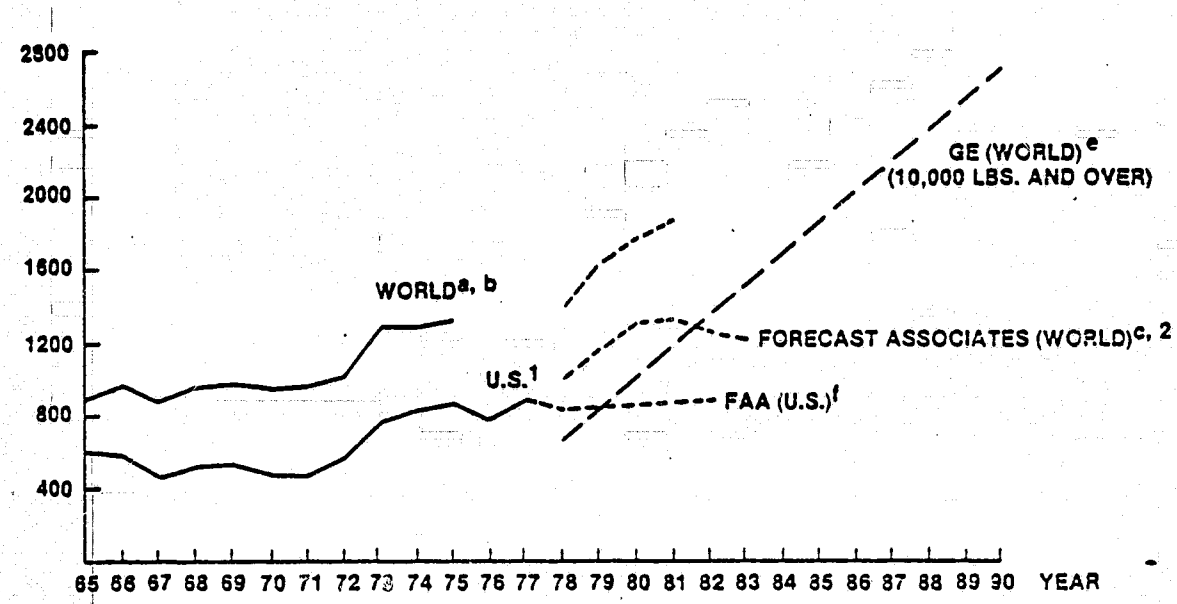
Additional sections address the Rotorcraft R&D funding levels both domestically and abroad as well as the recommended sources of pertinent market and technology information. Finally, the conclusions of the study are presented, summarizing the contemporary situation and offering an assessment of the U.S. position.

The Appendices contain raw tabular data and a memo describing the utility of the NASA Aviation Data Base.

II. CIVIL HELICOPTER MARKET

World civil helicopter production data are very limited. Aerospace Industries Association (AIA) publishes production data on U.S. manufacturers. However, there is no single source of information on foreign production. The Commission of the European Communities has recently (early 1970's) become interested in the competitive position of the European aerospace industry and as a result is producing an annual report, The European Aerospace Industry Position and Figures, which contains some information on the helicopter industry. Since all four major foreign helicopter producers, Aerospatiale (France), Agusta (Italy), Messerschmitt-Boelkow-Blohm (MBB) (Germany), and Westland (United Kingdom), are European and members of the European Economic Community, this annual report has the potential of becoming a good source of information. Individual helicopter manufacturers periodically perform market studies but these studies are proprietary in nature.

Figure 2.1 presents a summary of the projections available on the world civil helicopter market. The actual world output (1965-75) of helicopters is estimated by summing the AIA data on U.S. manufacturers' output and the survey data of Wayne Hitchcock on the foreign manufacturers' output. Based on this estimate 11,467 civil helicopters were produced from 1965 through



[1] EXCLUDES THE PRODUCTION BY FOREIGN LICENSEES.

[2] FORECAST ASSOCIATES CIVIL FORECAST IS FOR TURBINE HELICOPTERS ONLY. (RECENTLY, PISTON HELICOPTERS HAVE ACCOUNTED FOR ABOUT 20% OF WORLD PRODUCTION). DMS CIVIL FORECAST EXCLUDES HELICOPTERS PRODUCED BY AGUSTA AND MBB.

SOURCES:

[a] AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

[b] SURVEY BY WAYNE HITCHCOCK, FREE WORLD CIVIL HELICOPTER STUDY, 1976-1980 (PHOENIX, ARIZONA: SPERRY FLIGHT SYSTEMS), APRIL 1976.

[c] FORECAST ASSOCIATES, INC., WORLD HELICOPTER MARKET THROUGH 1983 (RIDGEFIELD, CT.: FORECAST ASSOCIATES), 1977.

[d] DEFENSE MARKETING SERVICES, MONTHLY INTELLIGENCE REPORTS: CIVIL AIRCRAFT (GREENWICH, CT.: DMS, INC.), 1977.

[e] AIRCRAFT ENGINE GROUP OF THE GENERAL ELECTRIC COMPANY FORECAST, ORI INTERVIEW.

[f] FEDERAL AVIATION ADMINISTRATION, FAA AVIATION FORECAST, FISCAL YEARS 1976-1987 (WASHINGTON, D.C.: USGPO), SEPTEMBER 1975.

FIGURE 2.1. WORLD CIVIL HELICOPTER PRODUCTION, 1965-90 (UNITS)

1975, 6,680 by U.S. manufacturers and 4,787 by foreign manufacturers. None of the forecasts of civil helicopter production done by (1) Defense Marketing Services (DMS), (2) Forecast Associates, (3) General Electric, and (4) The Federal Aviation Administration are quite satisfactory. The DMS forecast was calculated by summing the forecasts for individual models which are listed in Table 2.1. Absent from this list is any civil production by Agusta and MBB. The Forecast Associates forecast excludes all piston powered helicopters such as those produced by Hughes and Enstrom. One recent estimate suggested that annual piston powered helicopter production accounted for about 20 percent of the total number of civil helicopters produced that year. The General Electric forecast is only for civil helicopters weighing 10,000 pounds and over. The FAA forecast is for U.S. manufacturer civil output. Since each forecast excludes some part of the total world civil helicopter output, each should be considered conservative. There is great variation in the forecast period. Forecasts for more than 6 or 7 years are usually considered to have the possibility of a wide margin of error. The G.E. forecast, the only forecast to 1990, suggests that annual production generally will increase linearly and will quadruple between 1978 and 1990.

U.S. MARKET

The annual world civil production of helicopters going to the U.S. civil helicopter market (Figure 2.2) had to be estimated since the data are not collected directly. The U.S. civil helicopter market has been supplied by U.S. and foreign manufacturers. The number of civil helicopters produced by foreign manufacturers for the American market has been recorded since 1964 by U.S. customs officials in the official U.S. import statistics: U.S. Imports, Report FT226, under commodity number 6944030, U.S. Imports of Rotary Wing Aircraft, Non-Military. Prior to 1965 data on helicopter imports were not reported as a separate commodity category.

An estimate of the number of civil helicopters produced by U.S. manufacturers for the U.S. market was made by subtracting U.S. civil export of helicopters from the total U.S. civil helicopter production. Except when there are large inventory changes, the estimate will be quite accurate. The total U.S. civil helicopter market is then estimated by summing imports and the estimates of U.S. manufacturers. Figure 2.2 shows the total number of helicopters

TABLE 2.1
WORLD CIVIL HELICOPTER FORECAST 1978-82
BY TYPE

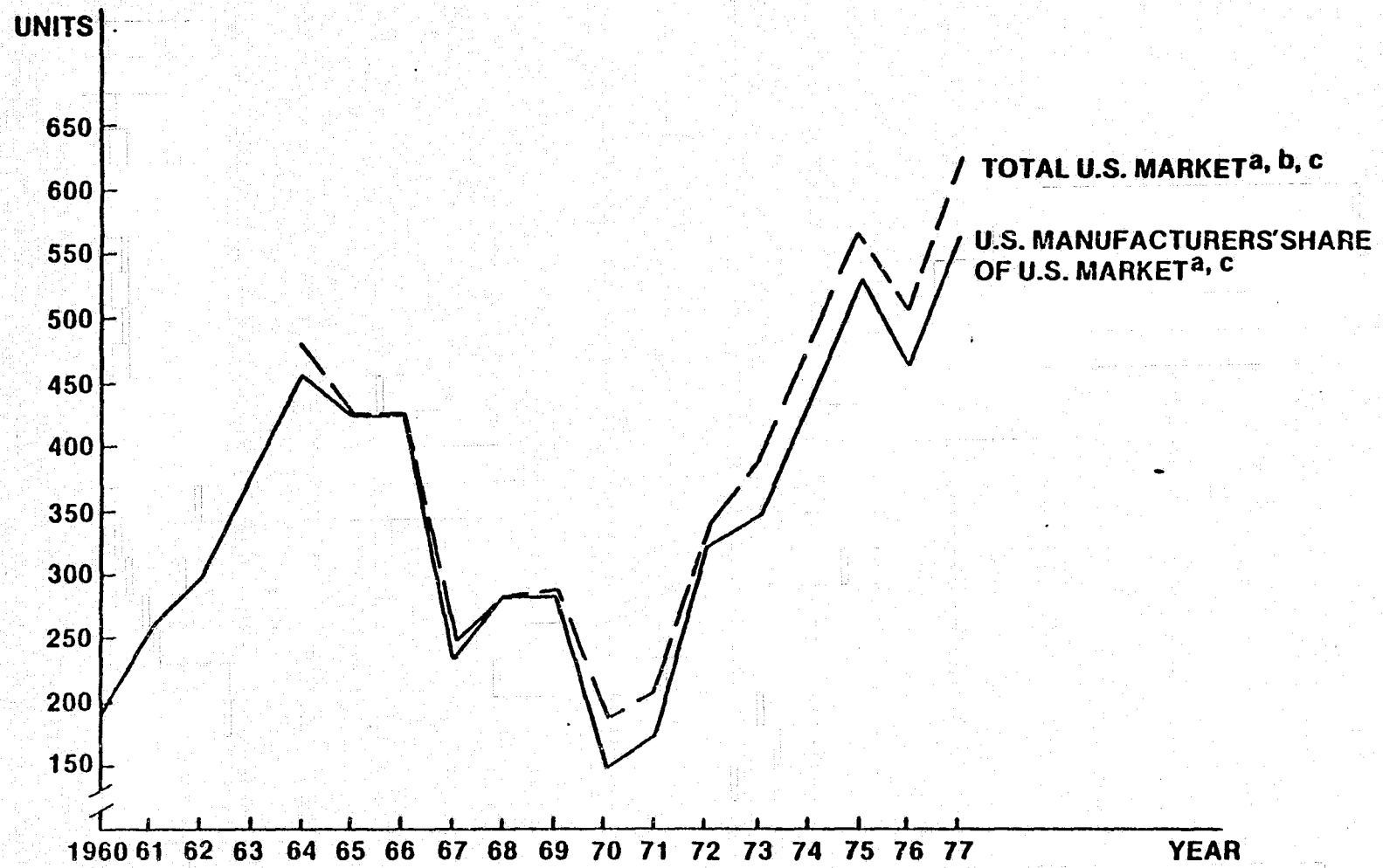
Manufacturer and Model	Produced thru 1977[c]	1978	1979	1980	1981	1982
AEROSPATIALE						
SA.315B Lama	184	20	14	12	10	
SA.316B/319B Alouette 3	1346	60	30	-	-	
AS.350 [350C Astar; 350B Ecureuil]	18	50	120	132	144	
SA.360C Dauphin	50	55	60	65	70	
SA.365 Dauphin 2	0	48	60	70	80	
SA.341/342 Gazelle	674	170	165	160	150	
SA.330J Puma	484	110	120	115	110	
Total	2756	513	569	554	564	
BELL						
BELL 205A-1	256	20	18	12	10	
AB 205A-1	90	3	3	2	1	
BELL 212	377	40	48	54	60	
AB 212	46	6	8	10	10	
JET RANGER (206A, 206B, 206C)	2340	260	275	295	300	300
LONGRANGER (206L, 206L-1)	170	85	95	105	110	120
BELL 222	5	-	65	130	150	180
Total	3257	414	512	608	641	600
ENSTROM						
F-28A	235	2	8	8	10	12
MODEL 280	100	2	8	12	14	18
F28C	116	72	70	74	80	90
MODEL 280C	106	72	76	86	100	110
Total	557	148	162	180	204	230
HUGHES						
MODEL 300 [269B/300C]	1810	115	125	135	140	150
MODEL 269/269A/YOH-Z	351	-	-	-	-	-
MODEL 500	1150	160	180	200	210	220
Total	3311	275	305	335	350	370
SIKORSKY						
S-76[b]	0	44	84	90	96	100
Worldwide Total	9881	1394	1632	1767	1855	N.A.

[a]Prototypes

[b]Does not include prototypes

[c]Production thru 1977 of Aerospatiale and Bell is estimated

Source: Defense Marketing Services, Monthly Intelligence Reports: Civil Aircraft (Greenwich, Ct.: DMS, Inc.), 1977.



SOURCES:

[a] AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

[b] U.S. BUREAU OF THE CENSUS, U.S. IMPORTS, REPORT FT246 (WASHINGTON, D.C.: USGPO), VARIOUS ISSUES.

[c] U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

FIGURE 2.2. U.S. CIVIL HELICOPTER MARKET, 1960-1977 (UNITS)

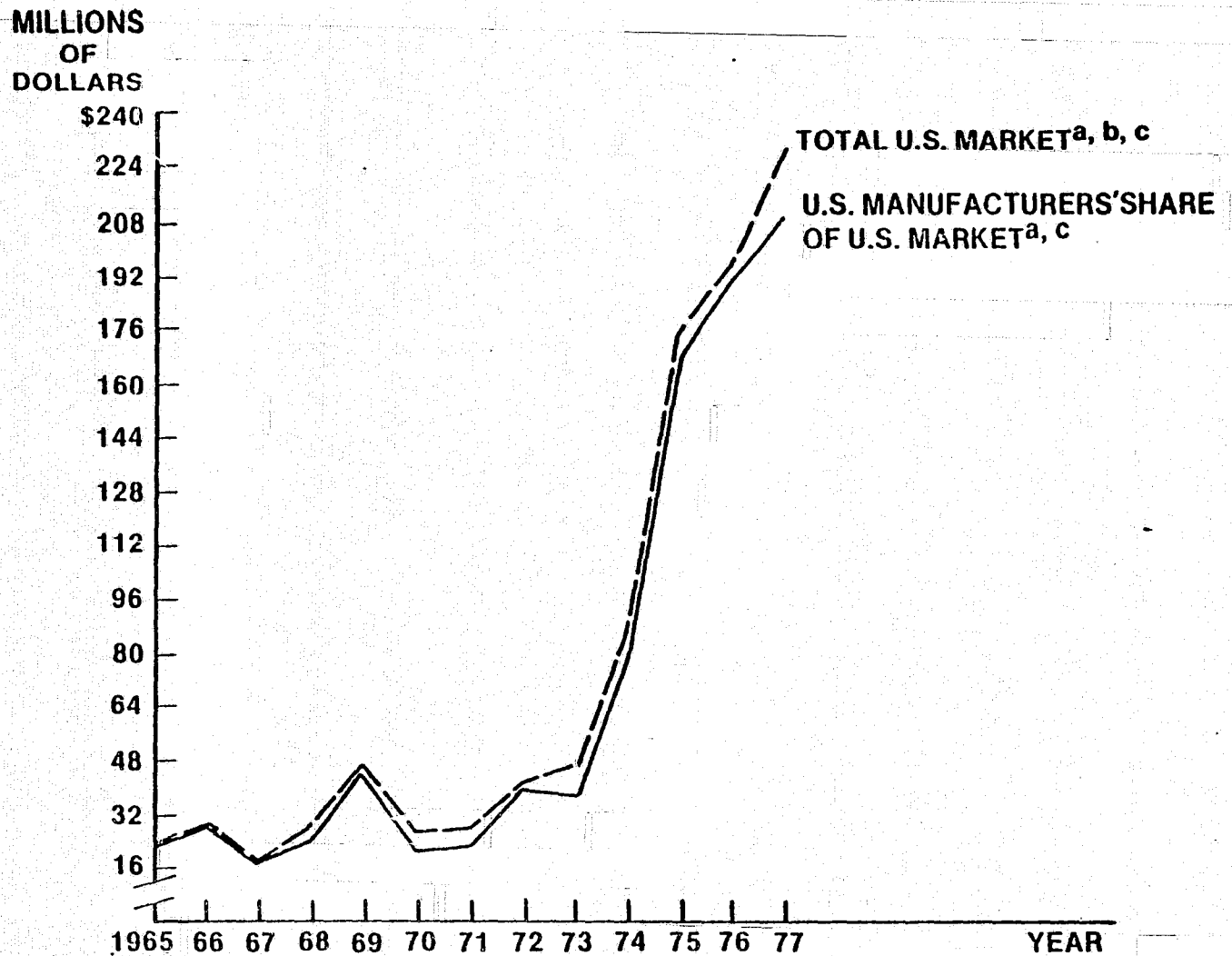
going to the U.S. market between 1964 and 1977 and the division of the total supply between U.S. and foreign manufacturing.

Between 1965 and 1977 inclusive the U.S. has purchased only 328 foreign civil helicopters compared to 5,057 domestically produced ones, giving foreign producers a 6 percent share (based on units) of the U.S. market. There is a great deal of year-to-year variation with the foreign share varying from zero to 21 percent.

The U.S. civil market for helicopters tends to be inversely related to the military market. During the 60's the U.S. military market for helicopters was rapidly increasing while the U.S. civil market was declining, with the military market peaking at 2800 units in 1968. The civil market did not bottom out until 1970 at 469 units. The two-year delay between the military peak and the civil trough is explained by the long lead times (1 to 2 years) in the helicopter industry and the advent of the 1969 recession reflecting the sharp sensitivity of the civil market to the business cycle. The U.S. civil market has been growing quite rapidly since 1970 except for a temporary decline in 1976 which probably reflected general business conditions and the uncertainty of the U.S. energy policy. Since 1970 the U.S. civil market has grown at an average rate of over 20 percent yearly including an off year in 1976.

Figure 2.3 shows the total value of the U.S. market for civil helicopters between 1965 and 1977 and the division of the total supply between U.S. and foreign manufacturers. Between 1965 and 1977 inclusive, the U.S. has purchased about $61,000,000 of foreign helicopters compared to $912,000,000 of U.S. produced helicopters giving foreign producers an average share (based on value) of 6 percent of the U.S. market. The foreign share varied from zero to 19 percent over the 13-year period. The average cost of a foreign helicopter (excluding import duties) was about $187,000 compared to $180,000 for a domestically produced one.

The total U.S. expenditure on civil helicopters has increased rapidly and continuously since 1970 averaging over 40 percent annually. While part of the increase in expenditure can be attributed to inflation, the real U.S. expenditure on civil helicopters also has been growing rapidly.



SOURCES: [a] AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

[b] U.S. BUREAU OF THE CENSUS, U.S. IMPORTS, REPORT FT226 (WASHINGTON, D.C.: USGPO), VARIOUS ISSUES.

[c] U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

FIGURE 2.3. U.S. CIVIL HELICOPTER MARKET, 1965-77
(MILLIONS OF CURRENT $)

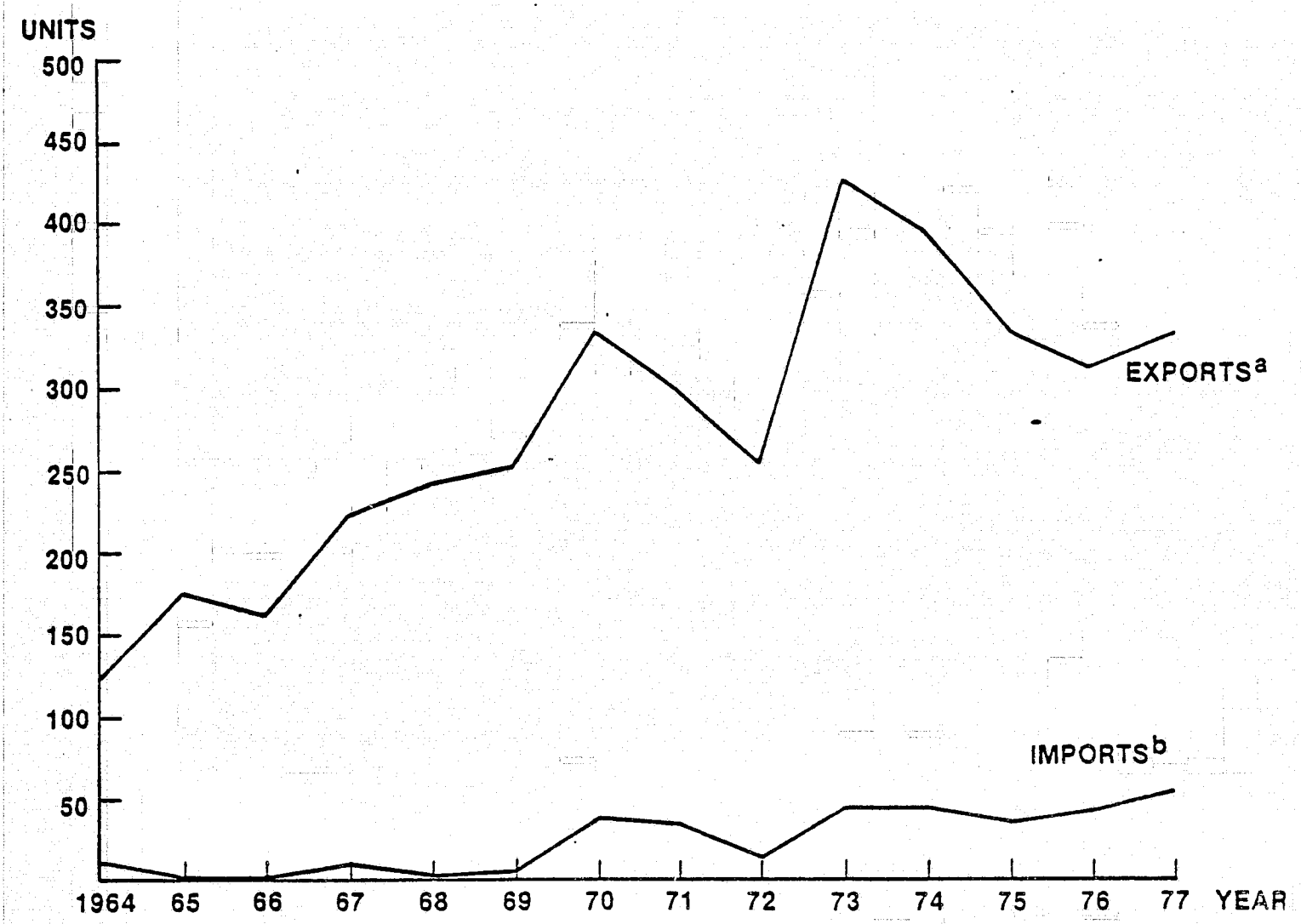
As the U.S. military helicopter market has declined, the U.S.civil market has increased. By 1977 the value output by U.S. manufacturers was equally divided between the civil and military market with $316,000,000 going to each. This represents a drastic change in the civil/military composition of U.S. output since the second half of the 1960's when civil output averaged about 6 percent of the U.S. output.

The U.S. is increasingly buying more expensive helicopters. This reflects a preference by U.S. consumers for larger and more sophisticated helicopters as well as a preference by U.S. manufacturers, historically the dominant suppliers of the U.S. market, to produce larger, more complex machines. U.S. civil helicopters have tended to be military derivatives (this is beginning to change as evidenced by the Bell 222 and Sikorsky S-76) and, therefore, bigger and more complex than many of the foreign produced machines. While there is considerably yearly variation in the average price of helicopters supplied to the U.S. market, in recent years U.S. manufactured helicopters have been considerably more expensive on the average than foreign helicopters.

U.S. IMPORTS AND EXPORTS

Data on the quantity of U.S. exports of civil helicopters are published monthly along with a cumulative year-to-date total by the U.S. Bureau of the Census. Data on the quantity of U.S. imports of civil helicopters is also published by the U.S. Bureau of the Census. U.S. export of civil helicopters is divided into two commodity categories based on weight. From 1965 through 1967 commodity category 7341025 represented exports of civil helicopters under 2,000 pounds and 7341030, 2,000 pounds and over. From 1960 through 1964 commodity category 79375 represented the export of civil helicopters under 3000 pounds and 79367, 3000 pounds and over. U.S import of civil helicopters from 1964 through 1977 was recorded under commodity number 6944030. Prior to 1964 U.S. import of civil helicopters was not reported as a separate commodity category.

Figure 2.4 shows that U.S. export of civil helicopters has tended to increase since 1964, although by no means steadily or continuously. During this 14-year period the U.S.exported 3,861 civil helicopters while importing only 318. Prior to 1970, the U.S. imported very few civil helicopters. Since



SOURCES: [a]U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

[b]U.S. BUREAU OF THE CENSUS, U.S. IMPORTS, REPORT FT246 (WASHINGTON, D.C.: USGPO), VARIOUS ISSUES.

FIGURE 2.4. U.S. IMPORT AND EXPORT OF CIVIL HELICOPTERS 1964-77 (UNITS)

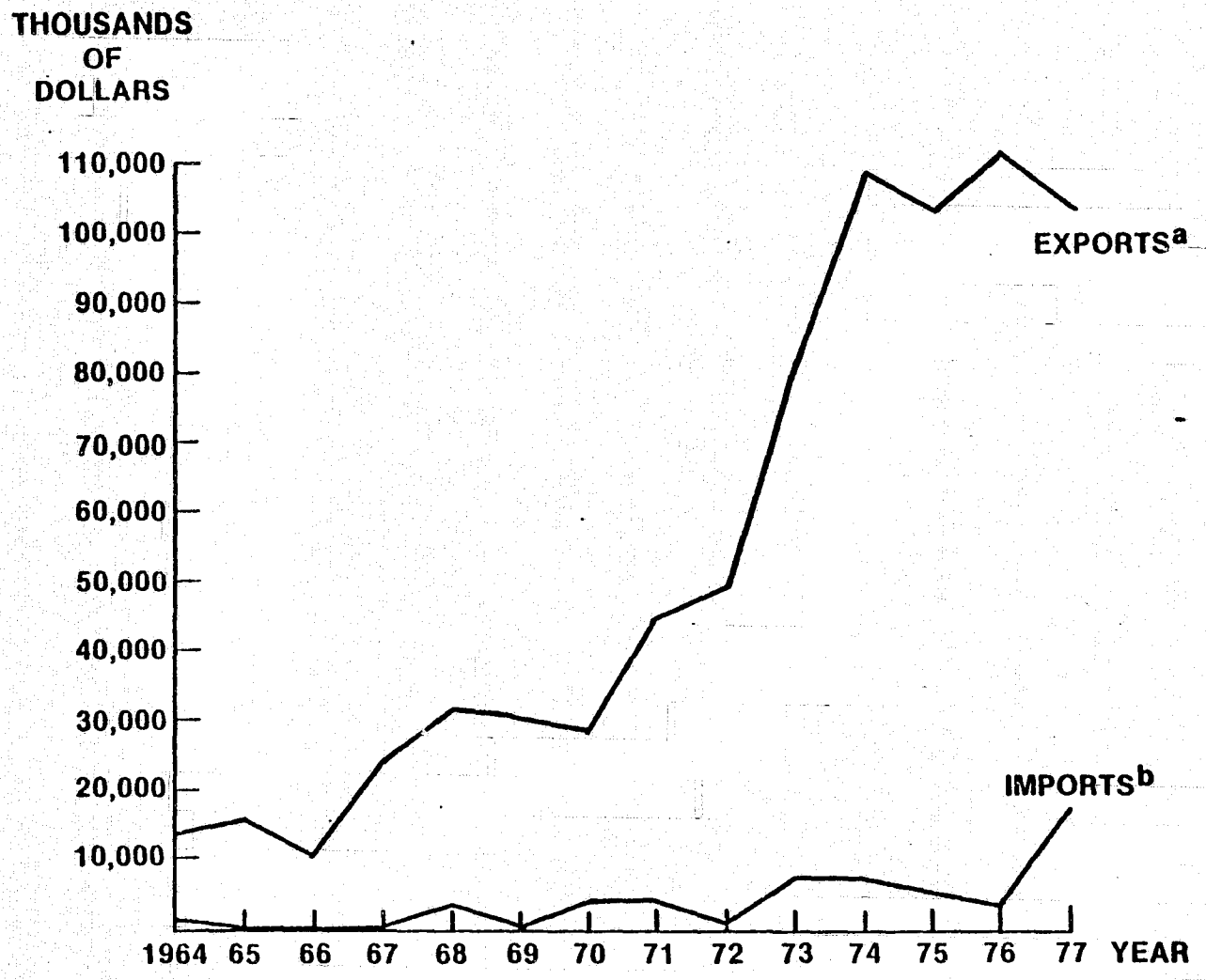
1969 the number of civil helicopters imported has ranged from 12 in 1972 to 56 in 1977. Since 1968, U.S. net annual export of civil helicopters has been in the range of 242 to 384 with much annual variation.

Figure 2.5 shows the annual value in current dollars of U.S. import and export of civil helicopters. From 1964 through 1977 the total value of U.S. exports of civil helicopters was $769,542,000 while the value of imports was only $62,311,000. U.S. net exports had tended to increase over the period but neither steadily nor continuously.

Between 1970 and 1975 there was a rather sharp rise in the value of civil helicopter export. In 1977 there was a sudden large increase in the value of imports.

The average price, calculated by dividing the total value of exports (imports) for the 14-year period by the total number of helicopters exported (imported), of an exported helicopter was about $200,000 while the average price for an imported one was $190,000. For 1977 the average price for an exported helicopter was about $329,000, while the average price for an imported one was about $323,000.

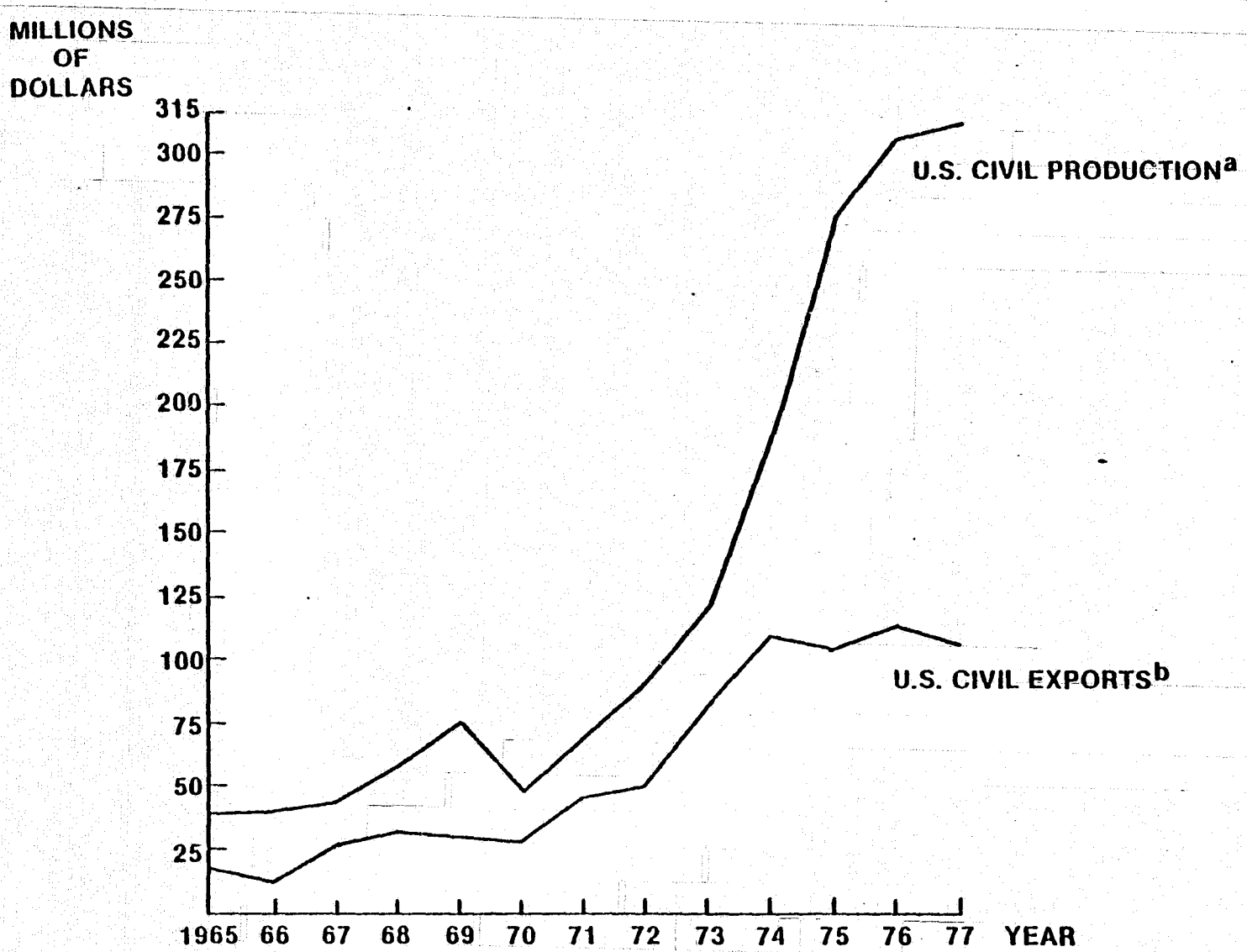
From 1965 through 1977 the total value of output of U.S. civil helicopters was 1.7 billion dollars. U.S. manufacturers exported civil helicopters worth 755 million dollars during the same period. Over the 13-year period, U.S. manufacturers exported on the average about 45 percent of the total value of their civil output. The share of production being exported has generally been declining since the mid-to-late 60's, dropping to 33 percent in 1977. The growing share of the value of U.S. manufacturers' civil output going to the domestic market is illustrated in Figure 2.6. This trend is probably explained by a number of factors. Since 1970 a rapidly growing U.S. civil market has been dominated by U.S. manufacturers. This has provided U.S. producers with a readily accessible demand. Secondly, the European manufacturers were becoming major suppliers of civil helicopters in several foreign countries, thereby limiting the growth of foreign markets to U.S. producers. Thirdly, U.S. manufacturers licensed a number of foreign producers to produce U.S. designed helicopters (e.g. Agusta).



SOURCES: [a]U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

[b]U.S. BUREAU OF THE CENSUS, U.S. IMPORTS, REPORT FT426 (WASHINGTON. D.C.: USGPO), VARIOUS ISSUES.

FIGURE 2.5. U.S. IMPORT AND EXPORT OF CIVIL HELICOPTERS, 1964-77 (000's CURRENT DOLLARS)



SOURCES: [a] AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

[b] U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

FIGURE 2.6. U.S. CIVIL PRODUCTION AND EXPORT OF HELICOPTERS, 1965-77 (MILLIONS OF CURRENT DOLLARS)

WORLD FLEET

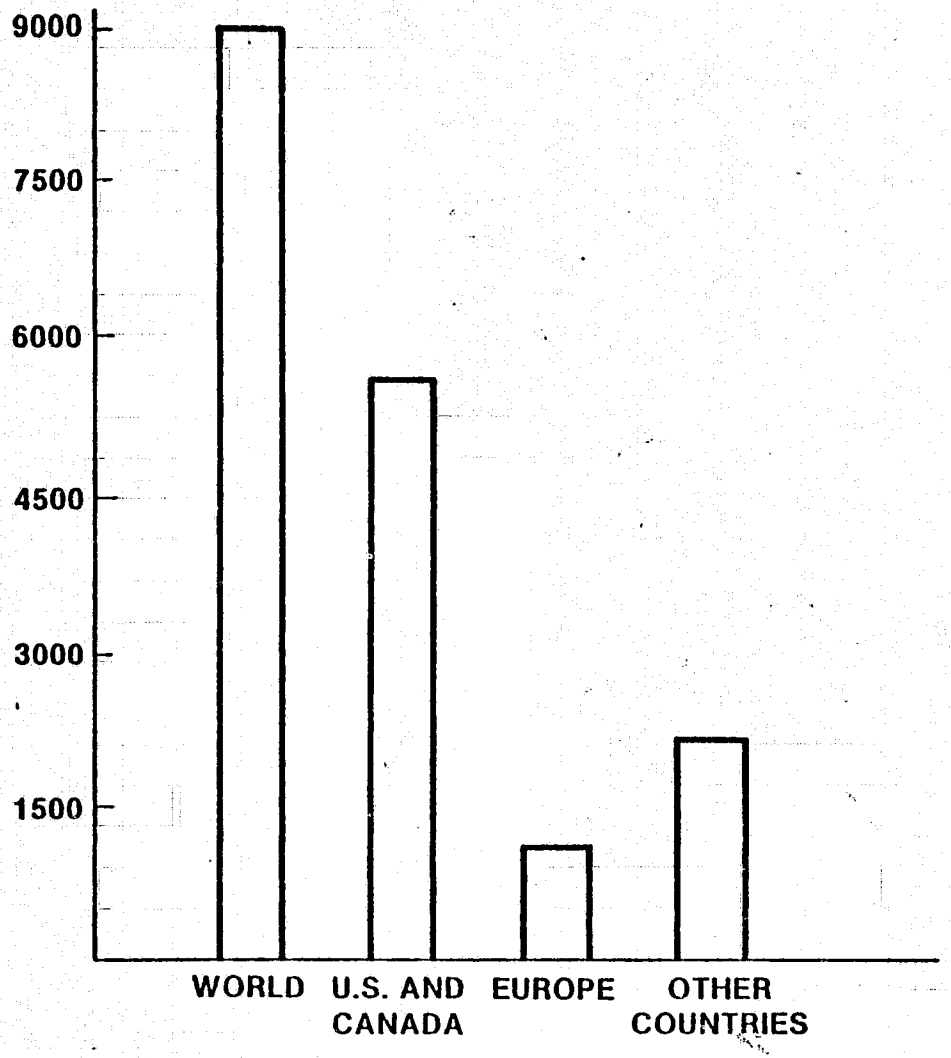
The U.S. has dominated the world consumption of civil helicopters, as illustrated in Figure 2.7. The Commission of the European Communities estimated that in 1975 out of a world (excluding USSR and People's Republic of China) civil fleet of 9,000 helicopters, 5,670 or 63 percent of the total reside in the U.S. and Canada. Europe owns only 1,180 helicopters or 13 percent of the world civil total.

There is considerable variation in estimates of civil fleets. The International Civil Aviation Organization (ICAO) in 1975 reported 10,147 registered helicopters in the worldwide fleet and 6,007 in the U.S. and Canadian civil fleets. In the same year the AIA reported only 5,222 helicopters operating in the U.S. and Canada. It is expected that registered aircraft will exceed active aircraft since at any particular time some registered aircraft will be inactive, but there is no obvious explanation why the European estimate of the U.S. and Canadian fleets exceeds the Aerospace Industries estimate by over 400 helicopters.

U.S. FLEET

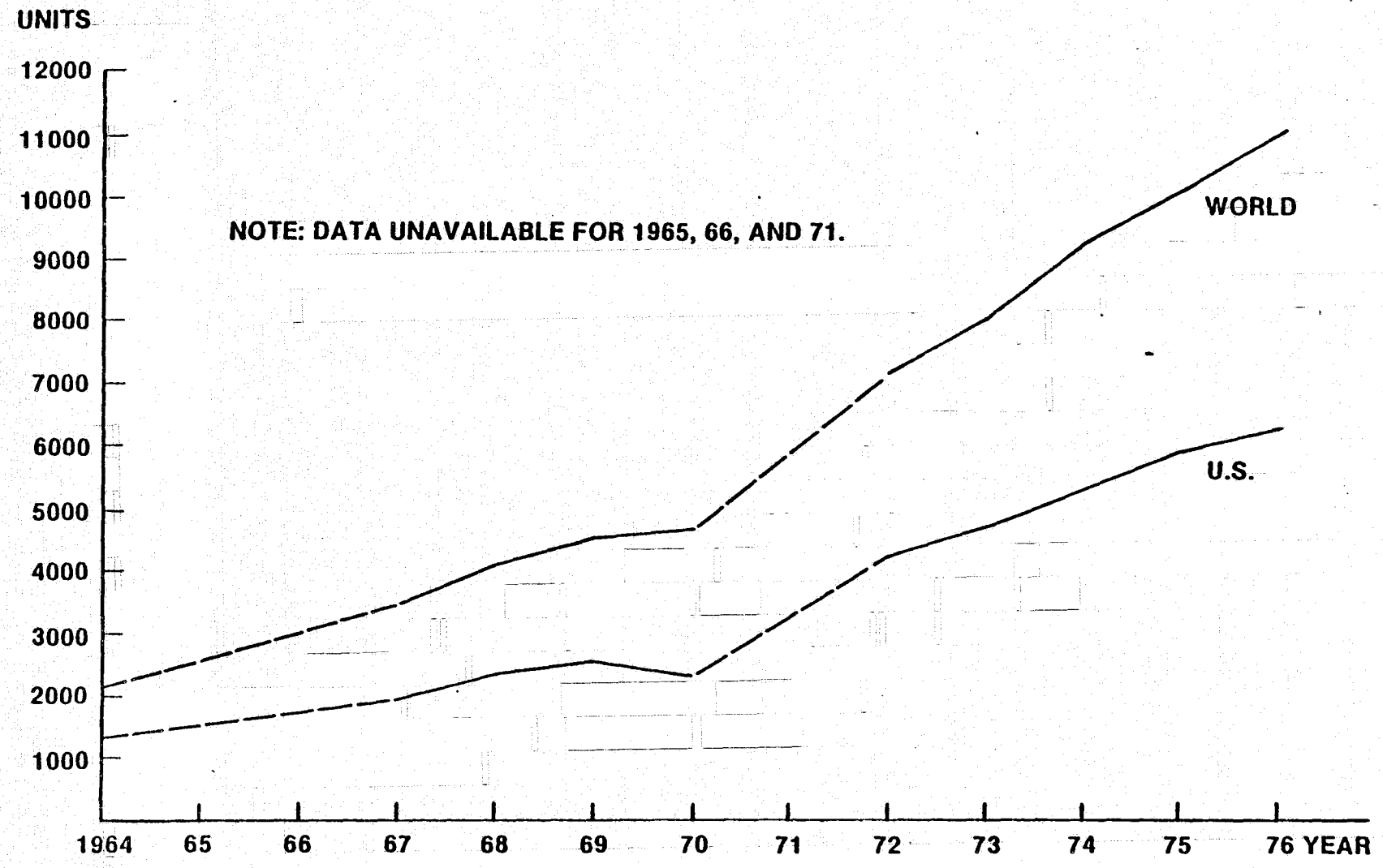
Figure 2.8 shows the historical growth of U.S. and world civil helicopters on register from 1964 through 1976. The data for 1965, 66 and 71 are missing because for those years the volumes of Civil Aircraft on Register, containing the data, were unavailable. The worldwide helicopter fleet total includes the U.S. but is defined to exclude the USSR and the People's Republic of China.

Both the U.S. and world helicopter fleets grew substantially more rapidly after 1970. In the six-year period beginning with 1964, the U.S. fleet increased by 171 percent versus 213 percent for the world. In the six-year period beginning in 1970, the U.S. and world fleets grew by 281 percent and 240 percent respectively. The explanation for this rather dramatic increase in helicopter fleets beginning around 1970 is probably related to changes in both demand and supply conditions. In the late 1960's there were several technological improvements which made the helicopter more appealing to the civil sector. The production of military helicopters was at the same time declining rapidly as the Vietnam War was slowing. Helicopter manufacturers found themselves in a situation in which they not only had excess productive capacity but a real need and opportunity to shift to civil production.



SOURCE: COMMISSION OF THE EUROPEAN COMMUNITIES, THE EUROPEAN AEROSPACE INDUSTRY TRADING POSITION AND FIGURES, MIMEOGRAPHED, BRUSSELS, BELGIUM, AUGUST 2, 1977.

FIGURE 2.7. CIVIL HELICOPTER FLEET BY MAJOR WORLD AREAS, 1975 (UNITS)



SOURCE: INTERNATIONAL CIVIL AVIATION ORGANIZATION, CIVIL AIRCRAFT ON REGISTER (MONTREAL, CANADA: INTERNATIONAL CIVIL AVIATION ORGANIZATION), VARIOUS ANNUAL ISSUES.

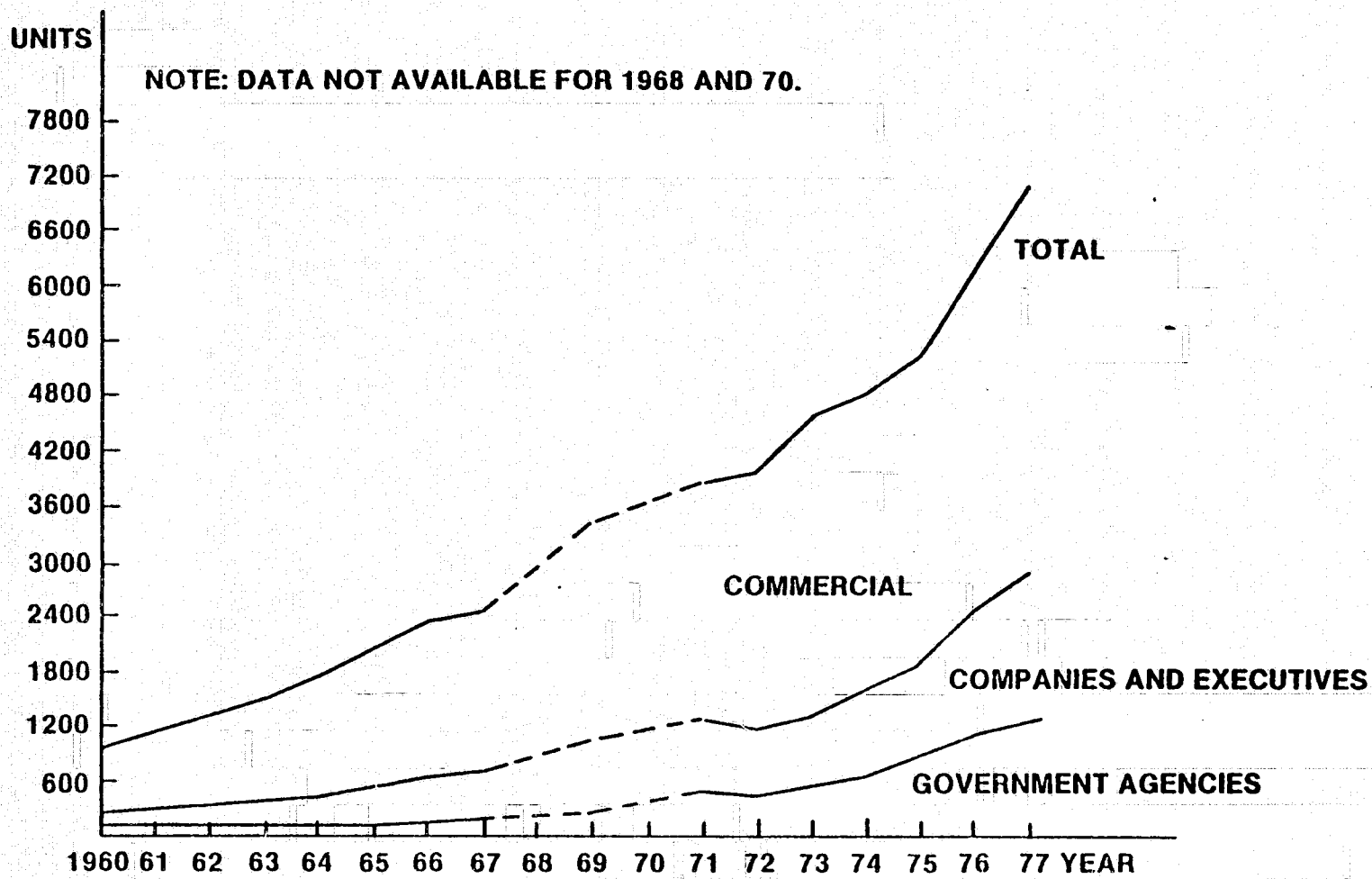
Figure 2.8. U.S. SHARE OF WORLD CIVIL HELICOPTERS ON REGISTER, 1964-76 (UNITS)

The U.S. share of the world's civil helicopters on register has remained relatively constant over the last ten years at around 58 or 59 percent except for 1970. There is no obvious explanation why in 1970 the U.S. share dropped for that one year to 49 percent.

Figure 2.9 shows the growth and development of the U.S. civil helicopter fleet since 1960 by major type of user. AIA, which publishes this data annually (except for 1968 and 1970), defines a commercial helicopter as one which is used primarily for hire. A private helicopter used primarily by its owner is classified with companies and executives. Helicopters operated by the government for non-military purposes are classified under government agencies.

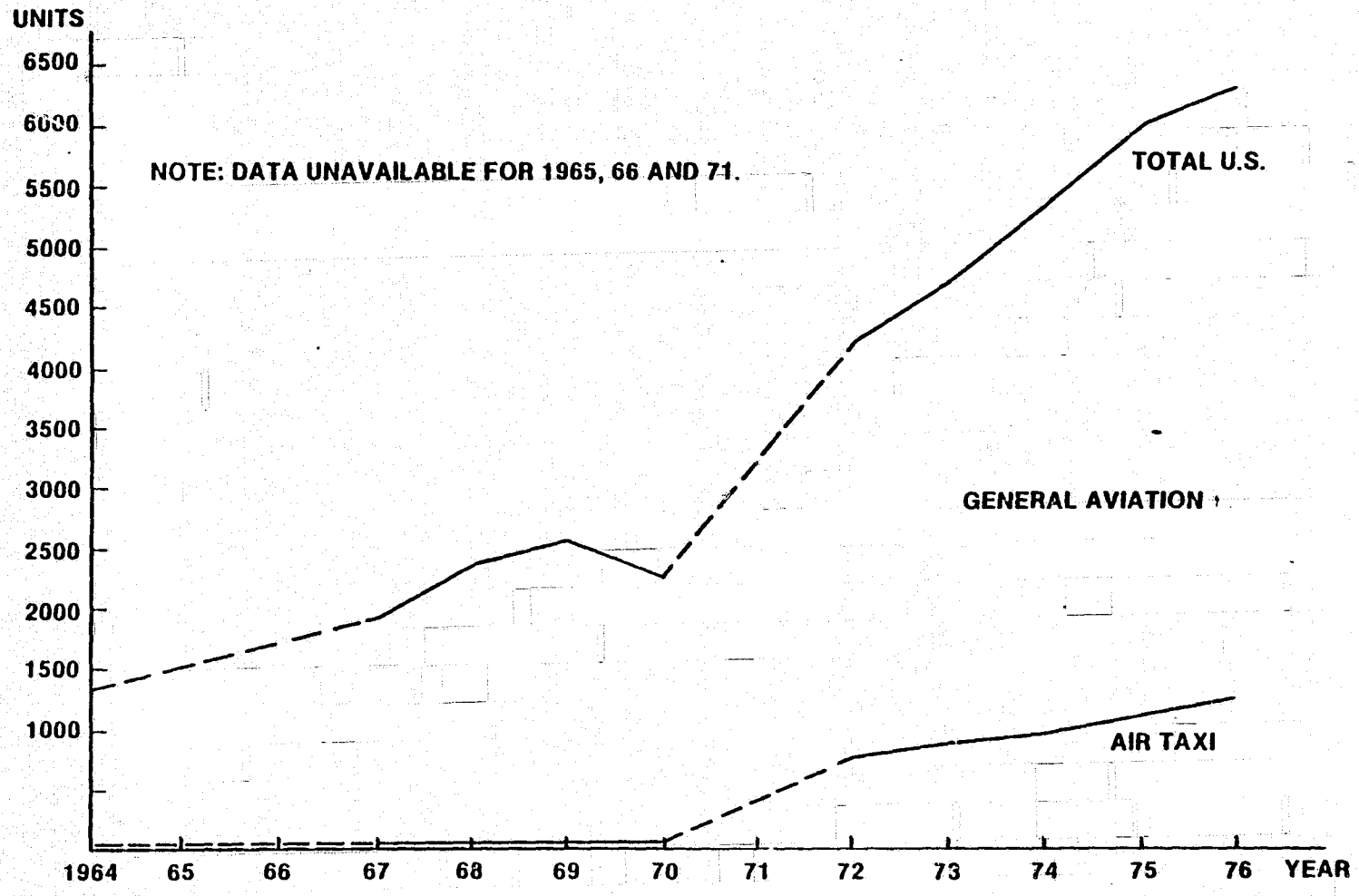
The U.S. total civil helicopter fleet increased more than 7-fold between 1960 and 1977 going from 936 to 7,160 helicopters with an average annual increase of almost 13 percent. The relative importance of different types of U.S. civil helicopter users has changed significantly over the 18-year period. In 1960 commercial helicopters accounted for 75 percent of the total with helicopters operated by companies and government accounting for only 15 and 10 percent respectively. By 1977 commercial helicopters had fallen by 15 percentage points, and company and government helicopters had increased by 7 and 8 percentage points respectively. Although company and government helicopter fleets have grown more rapidly than the commercial fleet, the commercial fleet of 4,294 helicopters in 1977 is still much larger than the company fleet (1,578) or the government fleet (1,288).

Figure 2.10 shows the growth and decrease of U.S. civil helicopters on register since 1964. The data for 1965, 66 and 71 are missing because the volumes of Civil Aircraft on Register containing the data for those years were unavailable. The IACO divides the total civil aircraft on register into two parts, commercial air transport operators and other operations. The ICAO does not give a definition of commercial air transport operators although a footnote states that this category includes data on air taxi operators. Based on the U.S. Census of Civil Aircraft data, it appears that most of the helicopters in the commercial air transport operator's category are used by air taxi operators.



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

FIGURE 2.9. CIVIL HELICOPTERS OPERATED IN THE U.S. AND CANADA BY USER, 1960-77
(UNITS)



SOURCE: INTERNATIONAL CIVIL AVIATION ORGANIZATION, CIVIL AIRCRAFT ON REGISTER (MONTREAL, CANADA: INTERNATIONAL CIVIL AVIATION ORGANIZATION), VARIOUS ANNUAL ISSUES.

FIGURE 2-10. U.S. GENERAL AVIATION AND TOTAL HELICOPTERS ON REGISTER 1964-76 (UNITS)

The total number of U.S. civil helicopters on register has grown from 1,325 in 1964, to 6,387 in 1976—an almost 5-fold increase.

U.S. GENERAL AVIATION FLEET PROJECTION

Figure 2.11 shows the development of the U.S. active general aviation (G.A.) helicopter fleet projected from 1966 to 1988. The data are recorded as of December 31, of each year.

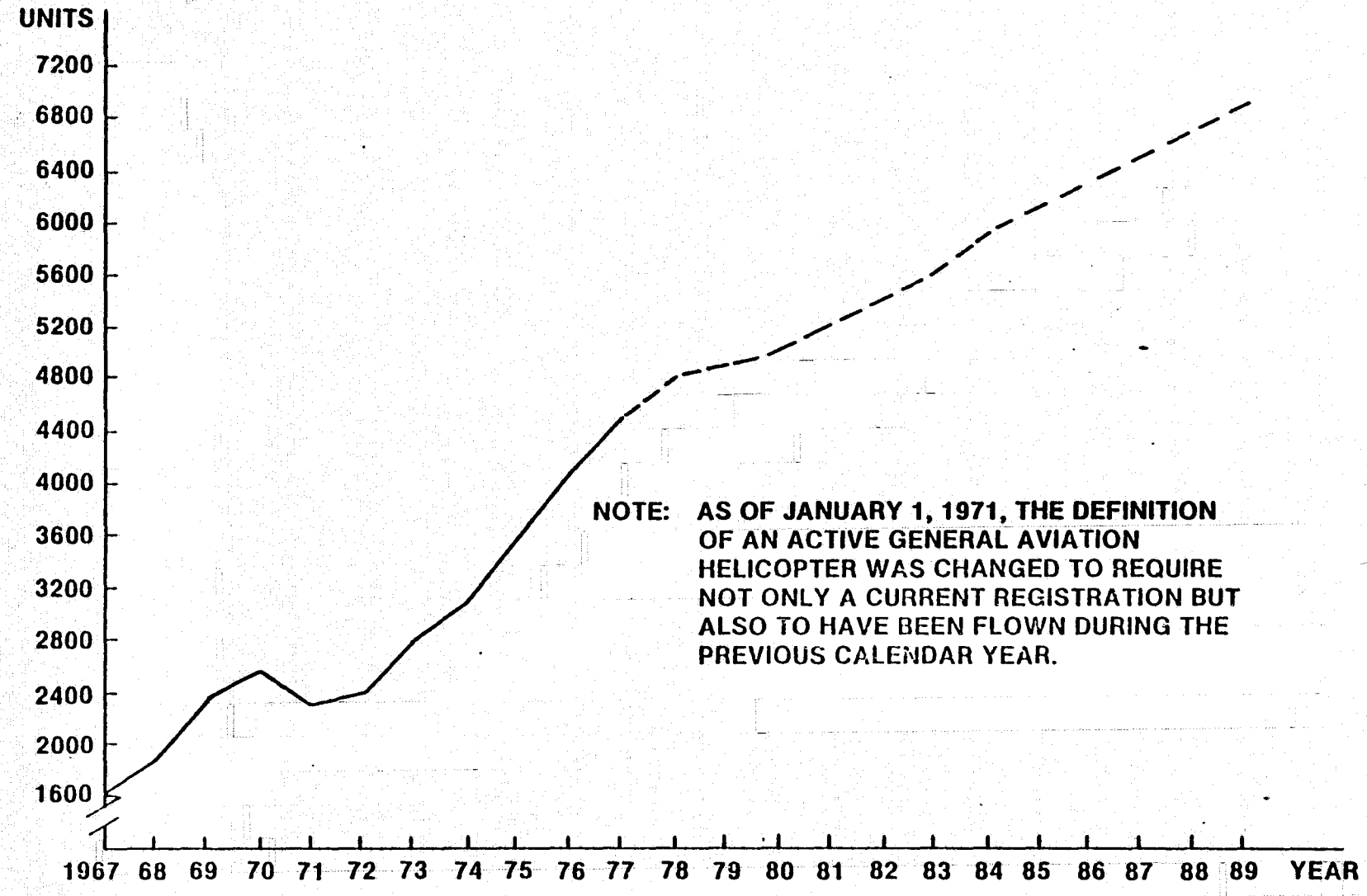
Several questions arise in interpreting the FAA data. The FAA says that its definition of general aviation excludes all certificated route air carrier, air commuter, and air taxi aircraft. However, upon closer inspection it appears that the FAA has included air commuter and air taxi aircraft in its data which according to the FAA data, equalled 974 helicopters in 1976 or about 20 percent of the active general aviation helicopter fleet recorded by the FAA.

The FAA active general aviation helicopter fleet usually runs between 65 and 75 percent of AIA civil helicopters operated. Since the two groups are attempting to measure the same entity, why is there such a divergence in their results? It is difficult to determine which estimate is better. In the 1970's the AIA data have been closer to the ICAO's data on U.S. civil helicopters on register. During the 1970's the AIA data on civil helicopters operated have averaged about 90 to 98 percent of ICAO's data on U.S. civil helicopters on register. Prior to 1970 the AIA estimate of civil helicopters operated considerably exceeded ICAO's civil helicopters on register. Since 1972 the FAA active GA fleet has averaged only 66 to 70 percent of ICAO's civil helicopters on register.

Table 2.2 illustrates the discrepancies.

Scheduled Certificated Helicopter Airlines

Figure 2.12 shows the U.S. helicopter traffic of certificated air carriers from 1960-76. The total traffic measured in ton-miles, consisted of four parts: passenger, U.S. mail, express, and freight. Passenger traffic has accounted for over 98 percent of total traffic. Starting in 1962 there was a rapid growth in total ton-miles until 1967, followed by rapid decline until 1971. The primary reason for this rather sudden increase followed by an equally sudden decrease is a pilot program whereby the Federal Government subsidized certificated helicopter airlines in order to demonstrate the

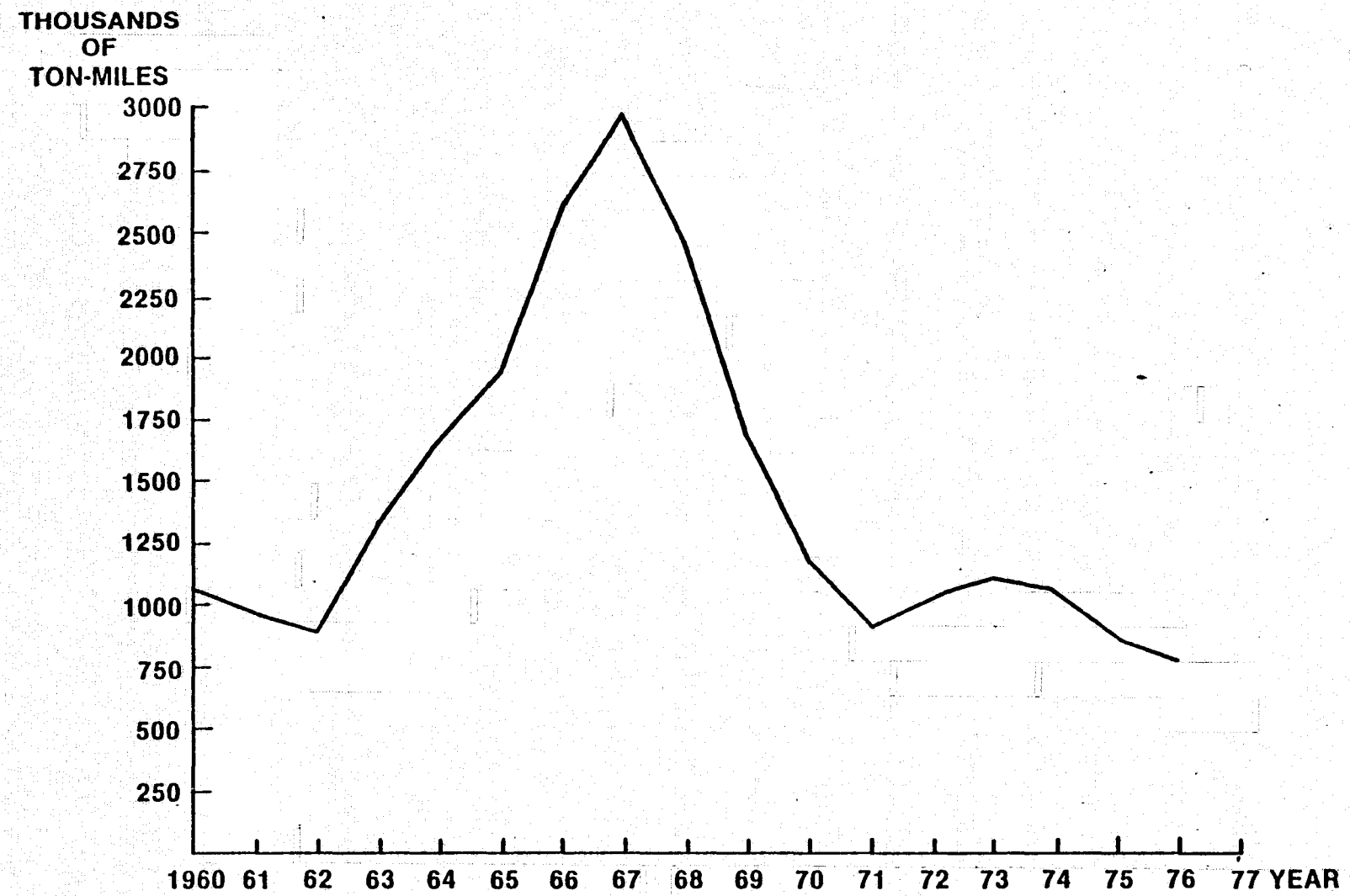


SOURCE: FEDERAL AVIATION ADMINISTRATION, FAA AVIATION FORECASTS, VARIOUS FISCAL YEARS (WASHINGTON, D.C.: USGPO), ANNUALLY.

FIGURE 2.11. ACTIVE GENERAL AVIATION HELICOPTER FLEET, 1967-89 (UNITS)

TABLE 2.2
COMPARISON OF GA FLEET DATA

Year	Total U.S. Civil Helicopters on Register (ICAO)	U.S. Helicopter Fleet of the Certified Route Air Carriers (CAB)	Active General Aviation Fleet (FAA)	Active Air Taxi Fleet (FAA)	General Aviation Helicopters Operated (AIA)
1964	1325				1767
1965					2053
1966					2318
1967	1925				2438
1968	2373				NA
1969	2583				3433
1970	2270		2255	528	NA
1971					3874
1972	4259	14	2800	650	4185
1973	4720	13	3100	640	4601
1974	5391		3600	745	4819
1975	6007		4100		5222
1976	6387		4500	974	6181
1977		4	4800		7160
1978		4	4900		
1979		5	5000		
1980		5	5200		



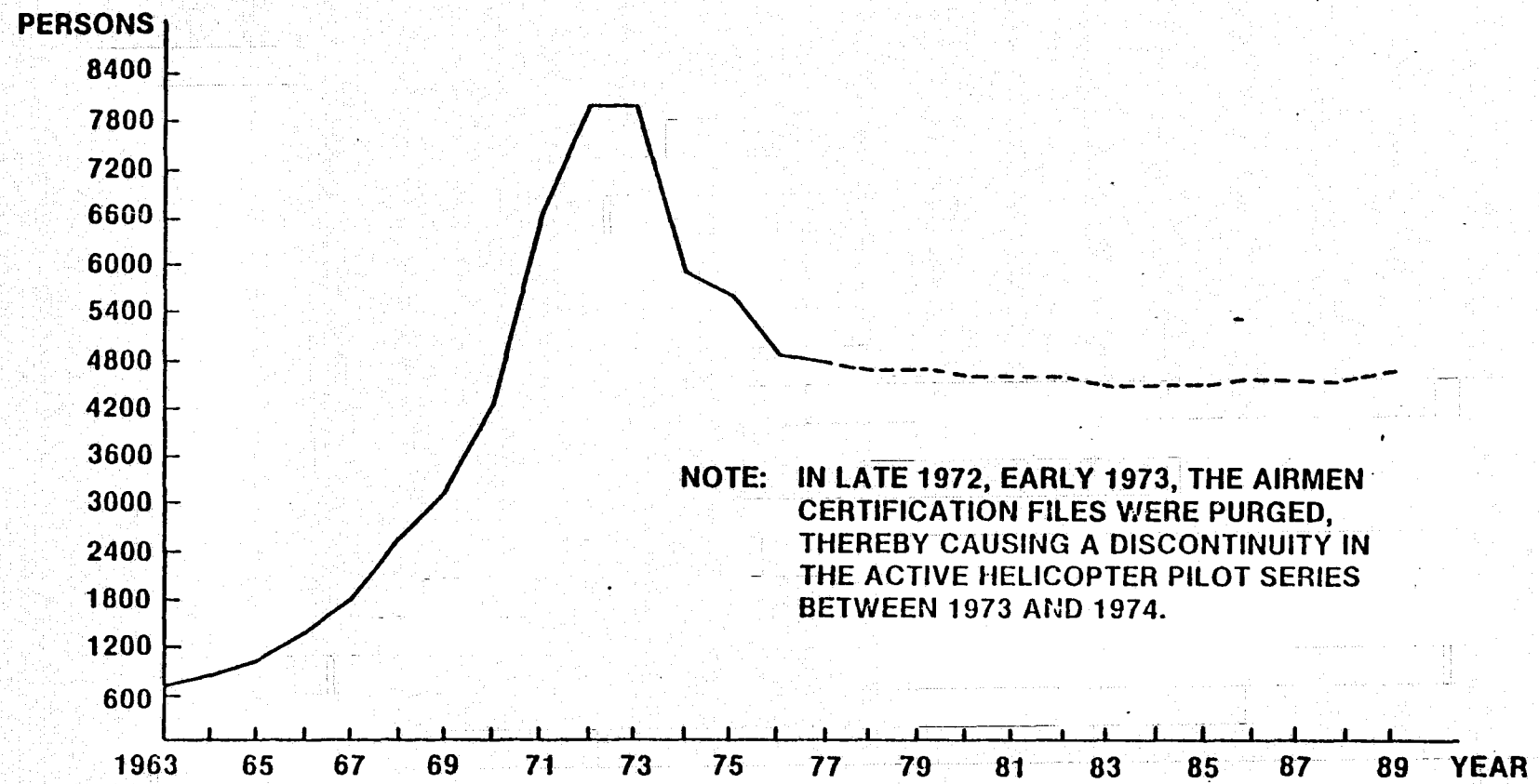
SOURCE: CIVIL AERONAUTICS BOARD, BUREAU OF ACCOUNTS AND STATISTICS, REPRODUCED IN AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), 1977/78.

FIGURE 2.12. U.S. HELICOPTER TRAFFIC OF SCHEDULED AIRLINES, 1960-76 (TON-MILES)

feasibility of urban helicopter operation. When the subsidies were discontinued in 1965, certificated helicopter airlines began to drop out of the market. Currently there is only one, New York Airways, remaining in operation.

Pilots

Helicopter demand is closely related to the cost and availability of complementary factors such as pilots. Figure 2.13 illustrates the actual and forecast supply of helicopter pilots. In the late 1960's there was a very rapid growth in the number of helicopter pilots due to the rapid growth in demand for military helicopters because of the Vietnam War. The sudden drop in the number of helicopter pilots in 1973 is due primarily to purging of the Airmen Certification Files. The FAA has forecast a level supply of helicopter pilots through 1989 at 4600 to 4700.



SOURCE: FEDERAL AVIATION ADMINISTRATION, FAA AVIATION FORECASTS, VARIOUS FISCAL YEARS (WASHINGTON, D.C.: USGPO), ANNUALLY.

FIGURE 2.13. ACTIVE U.S. HELICOPTER PILOTS, 1963-89 (PERSONS)

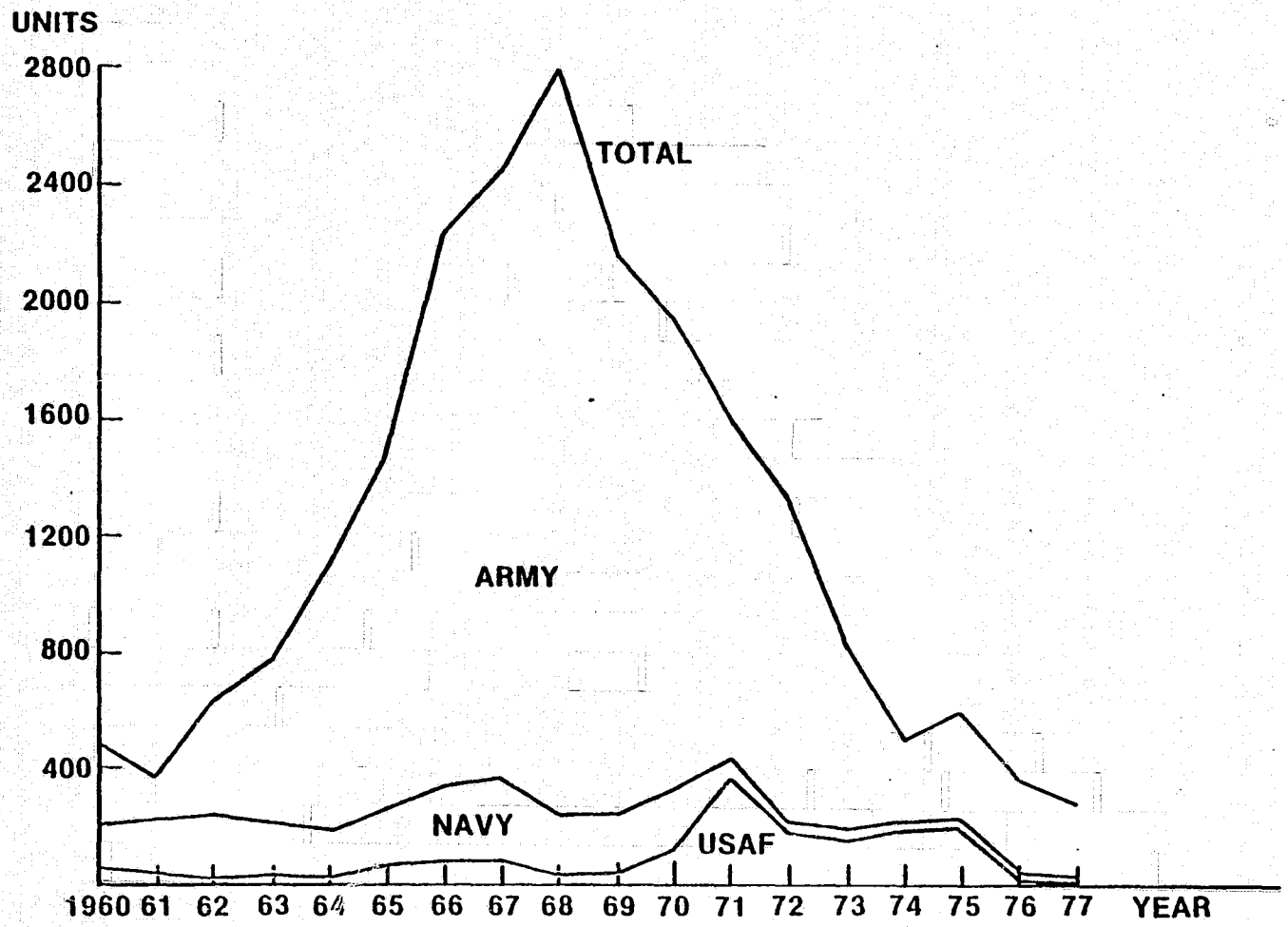
III. MILITARY HELICOPTER MARKET

U.S. MARKET

The U.S. Army, which boasts that it owns more aircraft than the Air Force and more ships than the Navy, consumes substantially more U.S.-produced military helicopters than its DOD counterparts. Figures 3.1 and 3.2 illustrate this point as they depict the breakdown of the U.S. military helicopter market by service in both units and dollars. These curves make an obvious point concerning the peak demand for military helicopters. It was at the zenith of the Vietnam War, circa the Tet Offensive.

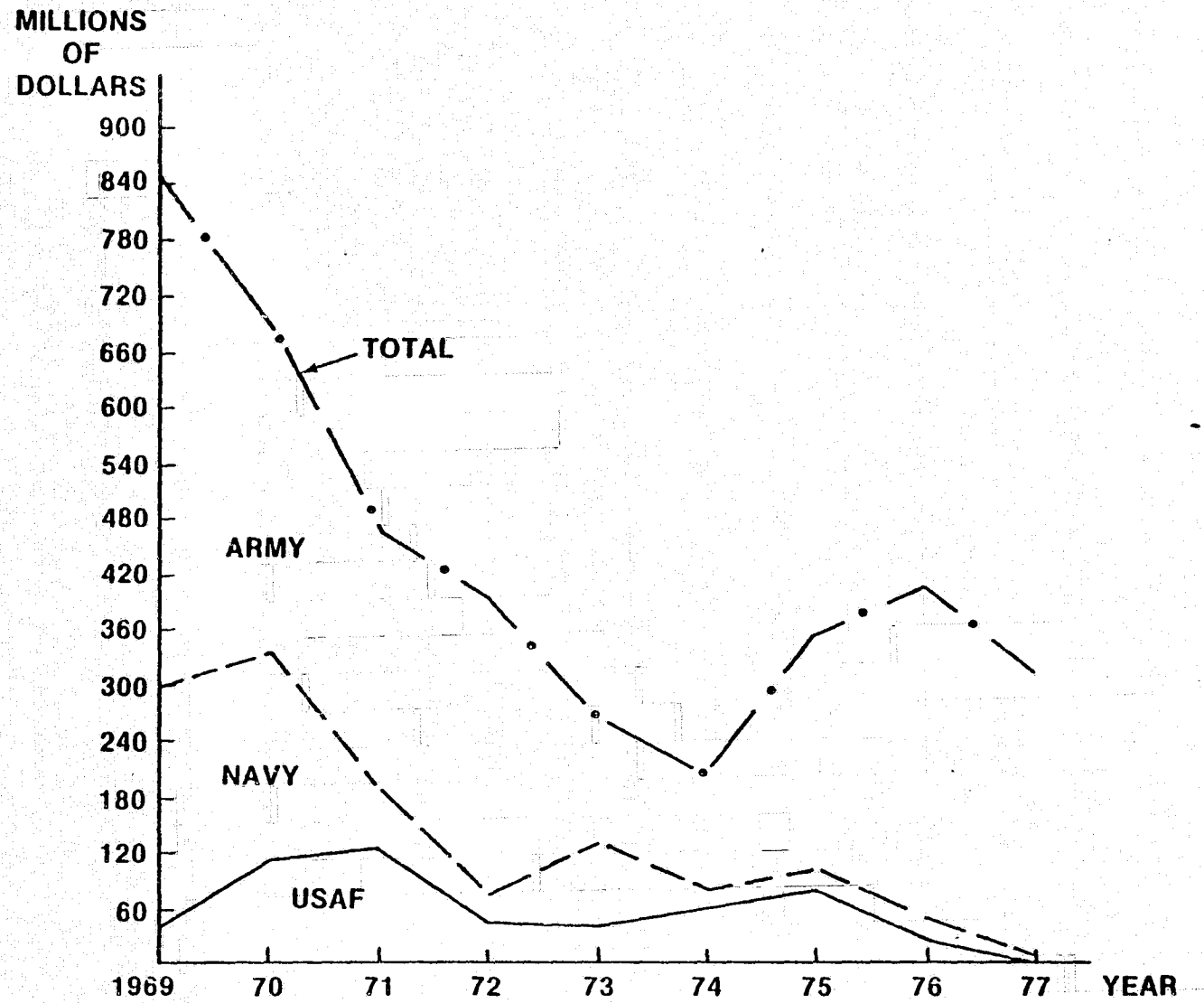
In addition to locking up the U.S. military market to date, U.S. helicopter manufacturers have also enjoyed a fairly lucrative export business, as demonstrated in Figure 3.3. Figure 3.4 indicates the level of current EEC fleets that were either manufactured in the U.S. or in Europe under U.S. license.

One immediately wonders about the size of Denmark's helicopter fleet and the prevalence of U.S.-designed helicopters in Germany's fleet. Since Germany's Aerospace Coordinator, State Secretary Martin Grüner, has given Germany's Aerospace Industry a mandate for self sufficiency, one wonders if they will



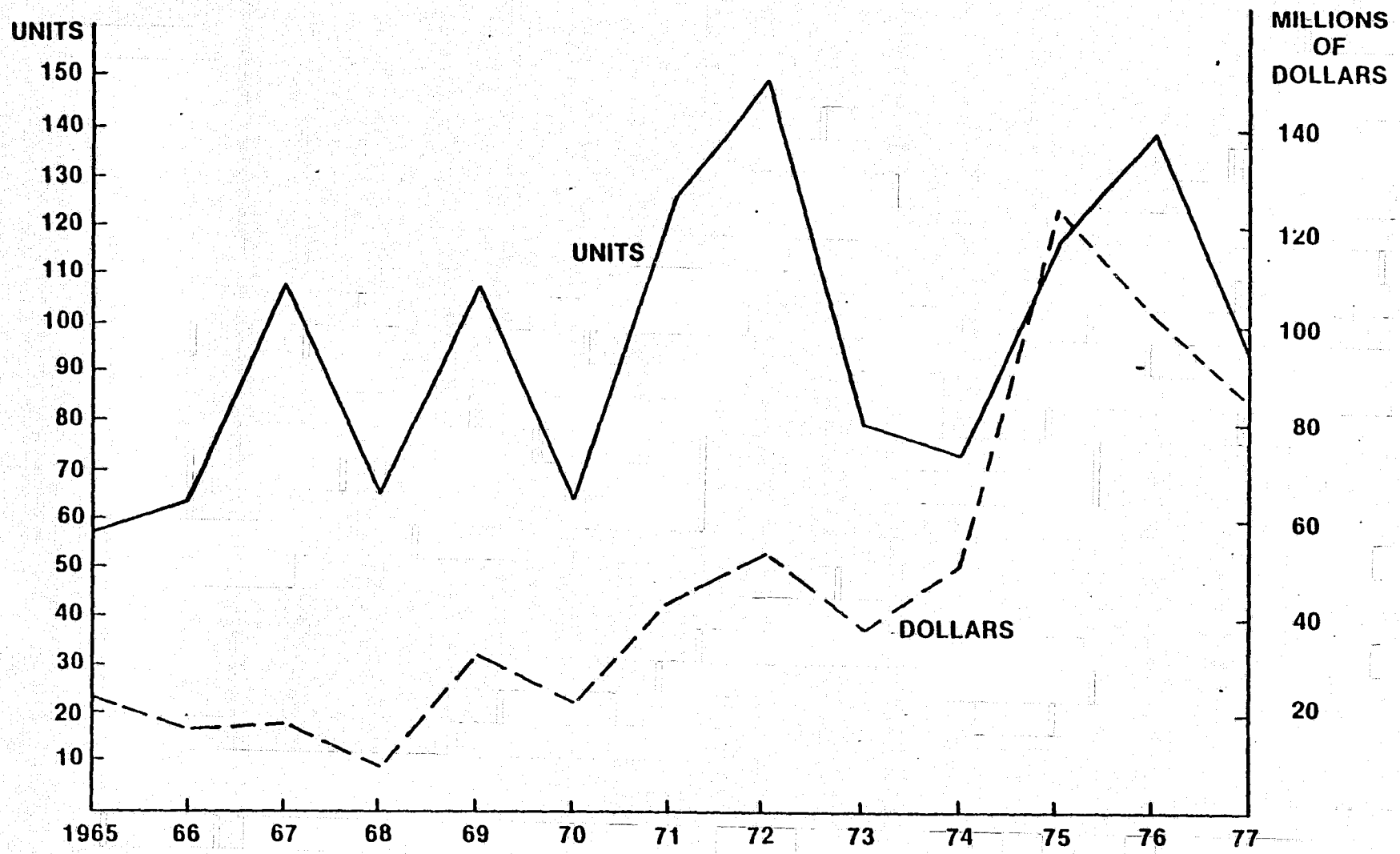
SOURCE: AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

FIGURE 3.1. U.S. MILITARY HELICOPTER MARKET BY SERVICE, 1960-77 (UNITS)



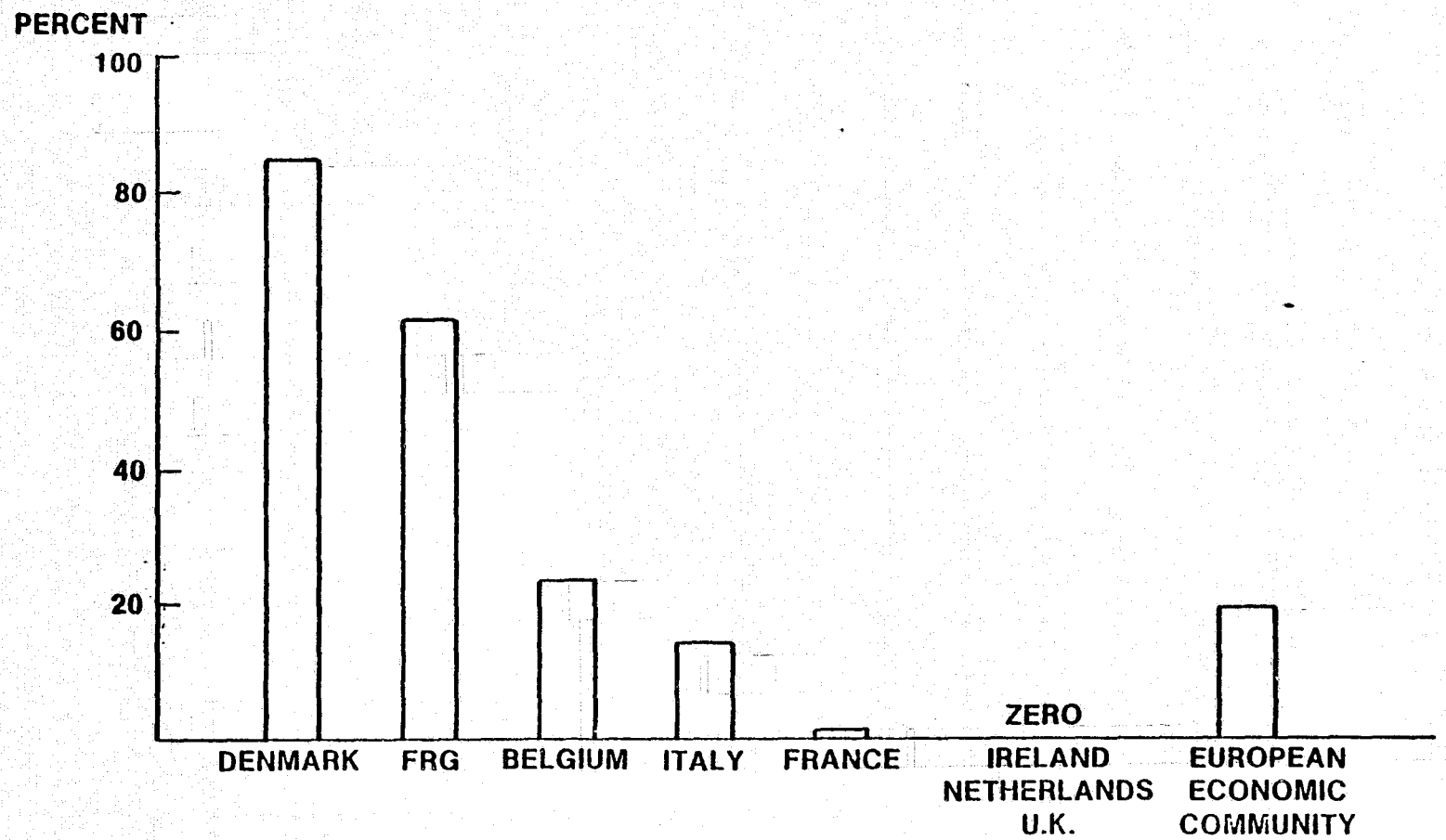
SOURCE: AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, AEROSPACE FACTS AND FIGURES (WASHINGTON, D.C.: AEROSPACE INDUSTRIES ASSOCIATION), VARIOUS ISSUES.

FIGURE 3.2. U.S. MILITARY HELICOPTER MARKET BY SERVICE, 1969-1977 (MILLIONS OF CURRENT DOLLARS)



SOURCE: U.S. BUREAU OF THE CENSUS, U.S. EXPORTS, REPORT FT410 (WASHINGTON, D.C.: USGPO), VARIOUS DECEMBER ISSUES.

FIGURE 3.3. U.S. EXPORT OF MILITARY HELICOPTERS, 1965-1976
(UNITS AND CURRENT DOLLARS)



SOURCE: COMMISSION OF THE EUROPEAN COMMUNITIES, THE AEROSPACE INDUSTRY TRADING POSITION AND FIGURES, MIMEOGRAPHED, BRUSSELS, BELGIUM, AUGUST 2, 1977.

FIGURE 3.4. U.S. DESIGNED SHARE OF EUROPEAN ECONOMIC COMMUNITY MILITARY HELICOPTER FLEET, 1975 (PERCENT BASED ON VALUE)

buy fewer American helicopters in the future. They may feel the need to continue to buy sophisticated U.S. war machines to deter the Soviet menace on their eastern front.

Figure 3.5 projects a quite steady U.S. military fleet into the late 1980's.

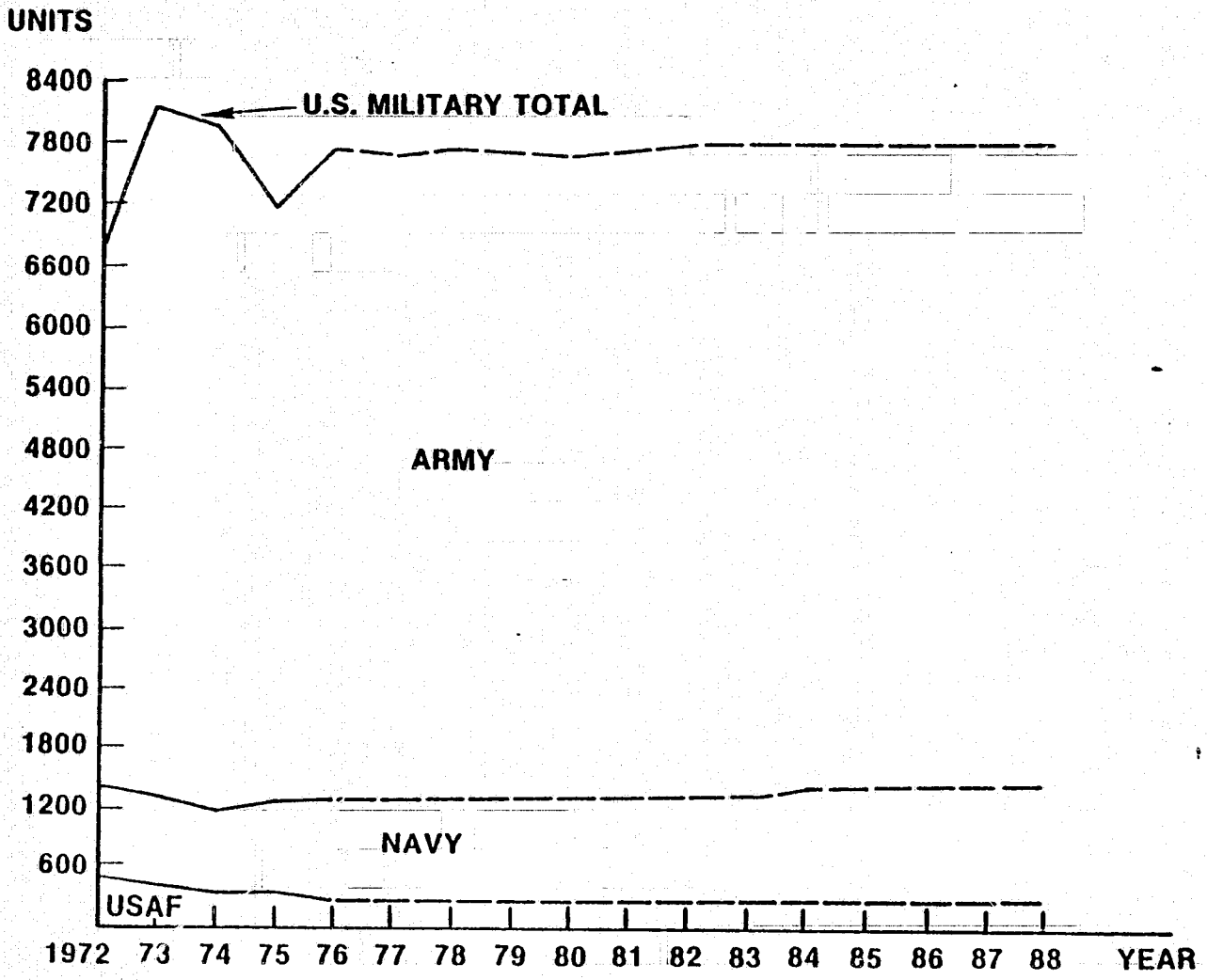
WORLD PRODUCTION FORECAST

Figure 3.6 illustrates the projected growth of the world military fleet of helicopters from 19,000 to approximately 21,000 between 1978-86. The U.S. military fleet is estimated to account for 50-55 percent of the free world fleet.

Figure 3.7 presents the DMS and Forecast Associates projections for military production. The DMS forecast is fairly complete in the models included in its forecast and the projected requirements for each (Table 3.1). However, some qualification must be given to their projected downturn in world production after 1984. Even if military production falls to below 500 units in 1986, the production levels must soon return to near 1000 units/year. Figure 3.6 showed a monotonic world military inventory forecast in excess of 20,000 helicopters into the 1980's. To maintain this fleet level of military helicopters, whose service life is less than 20 years, an eventual annual production of nearly 1000 units is required.

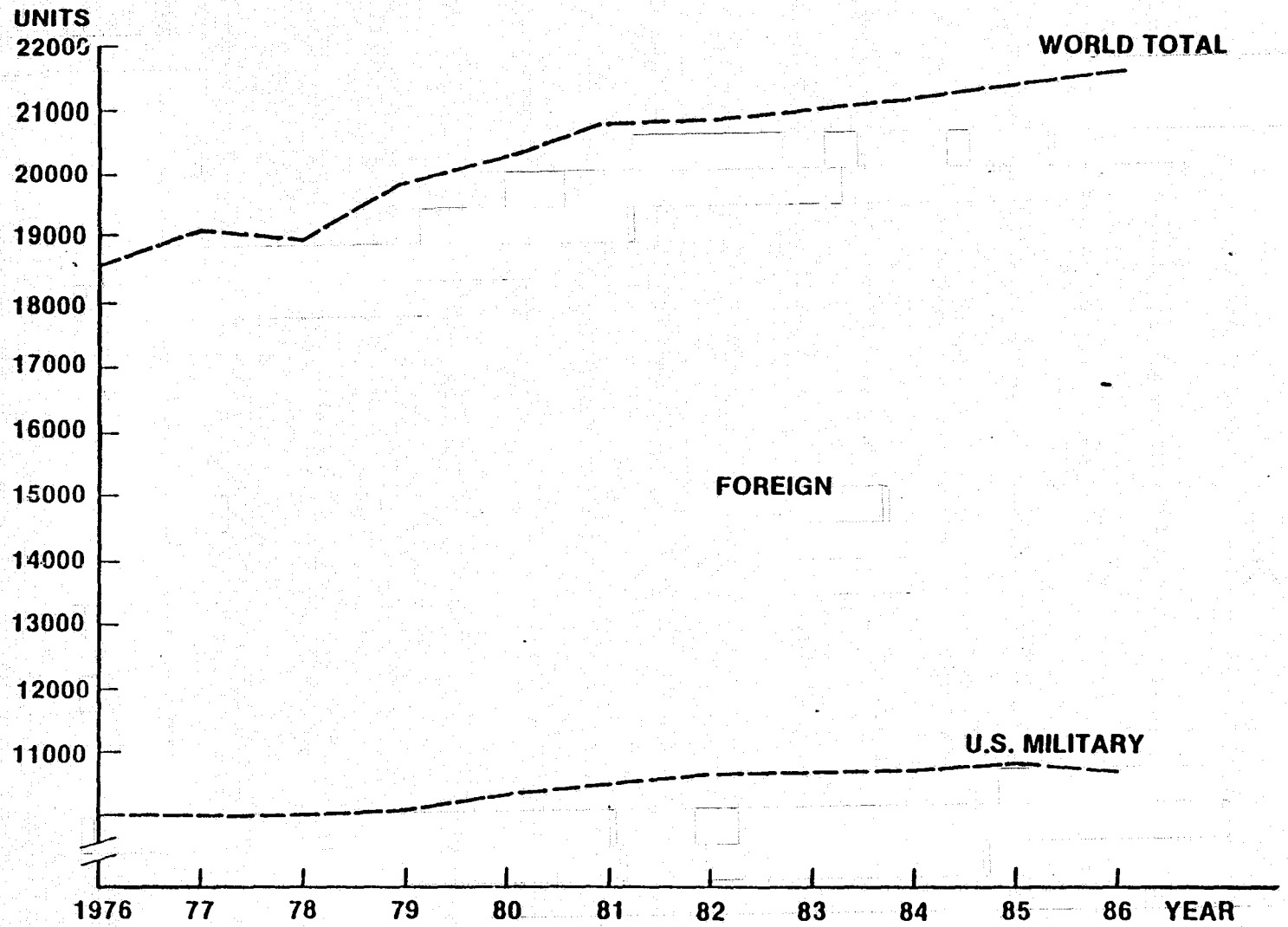
The DMS forecast of world military helicopter production is divided into four categories (attack, light, medium, and heavy) in Figure 3.8. The breakdown of helicopters into these four categories is listed in Table 3.2.

The DMS breakout of their forecast of military production into U.S. share, foreign share, and the contested or unallocated market is illustrated in Figure 3.9. Similar portioning of their forecast market for attack, light, medium and heavy military aircraft is presented in Figures 3.10 through 3.13.



SOURCE. FEDERAL AVIATION ADMINISTRATION, MILITARY AVIATION FORECAST, FISCAL YEARS 1977-88, REPORT FAA-AVP-76-15, MIMEOGRAPHED, AUGUST 1976.

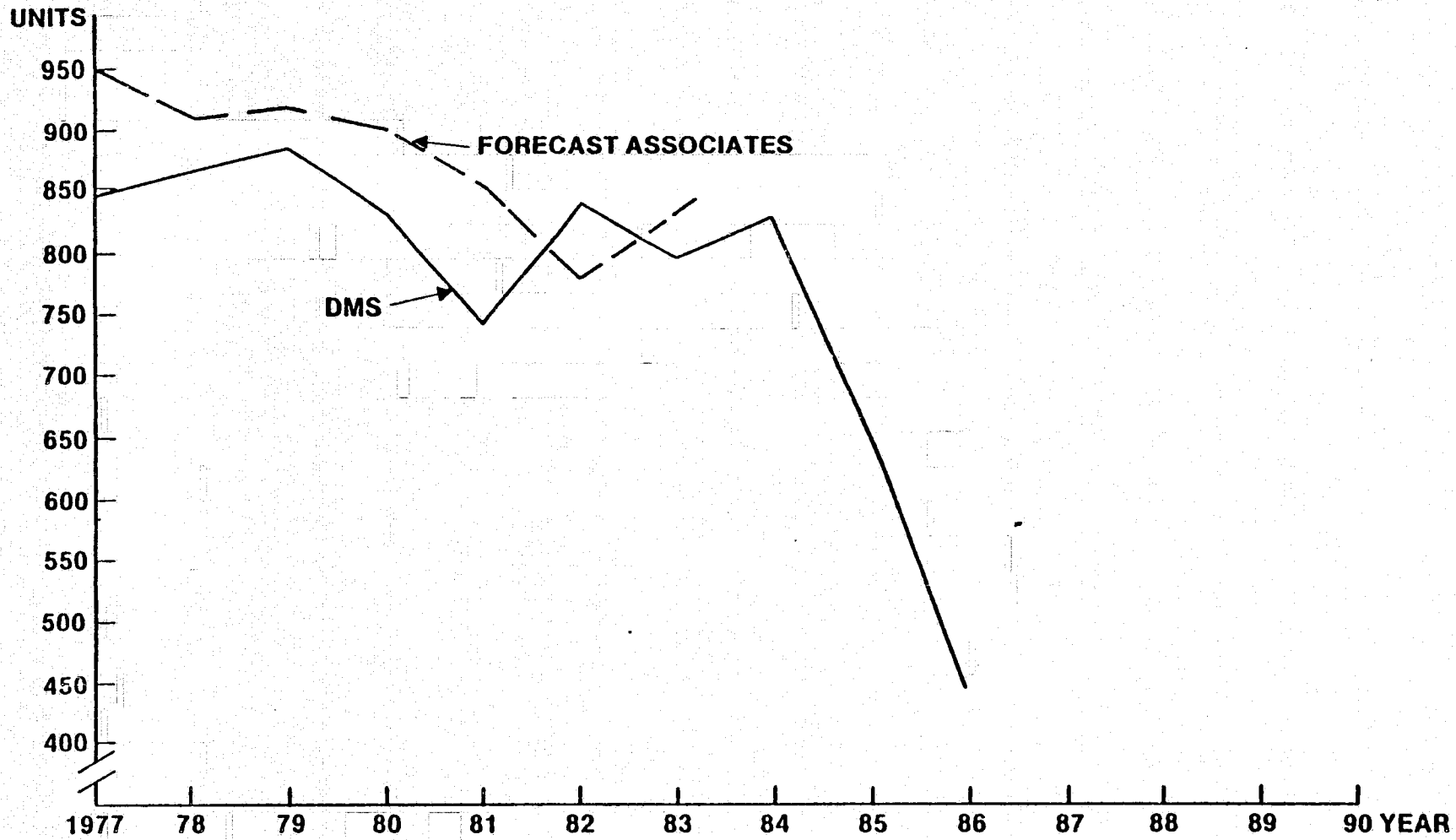
FIGURE 3.5. ACTIVE U.S. MILITARY HELICOPTERS IN CONTINENTAL U.S. BY SERVICE 1972-88 (UNITS)



SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

NOTE: 1976 ARE ACTUAL FIGURES. 1977-86 ARE FORECAST FIGURES.

FIGURE 3.6. WORLD MILITARY HELICOPTER INVENTORY FORECAST, U.S. AND FOREIGN MANUFACTURED, 1977-86 (UNITS)



SOURCES: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FORECAST ASSOCIATES, INC., WORLD HELICOPTER MARKET THROUGH 1983 (RIDGEFIELD, CT.: FORECAST ASSOCIATES, INC.), 1977.

FIGURE 3.7. WORLD MILITARY HELICOPTER PRODUCTION: FORECAST COMPARISON (UNITS)

TABLE 3.1
WORLD MILITARY INVENTORY FORECAST BY MANUFACTURER AND MODEL, 1977-86
(UNITS)

MANUFACTURER	Unit Price (000's 1976$)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Aerospatiale												
SA-315	$ 276	44	50	50	49	48	46	45	44	43	39	38
SA-316	225	787	773	756	738	719	703	675	632	598	565	553
SA-318	120	270	264	230	218	188	146	98	76	76	44	22
SA-319	318	37	37	40	40	40	40	37	31	30	28	27
SA-321	3,780	68	86	89	112	139	151	148	146	145	138	136
SA-330	2,000	294	323	383	418	431	421	419	414	409	398	393
SA-341	339	362	426	459	477	491	489	487	484	479	477	474
SA-342	350	20	28	44	62	71	77	83	82	82	81	79
SE-313	118	484	466	444	419	392	357	330	296	237	209	196
Total Aerospatiale		2366	2453	2495	2533	2519	2430	2322	2205	2099	1979	1918
Agusta												
A -109	$ 573	5	5	28	60	72	72	72	71	71	69	68
A -129	573	0	0	0	0	0	16	24	36	48	60	60
AB-204	350	216	212	202	185	170	160	130	100	97	95	93
AB-205	725	304	348	359	351	347	335	329	311	305	293	290
AB-206	1,100	404	415	432	429	420	411	406	399	391	383	377
AB-212	575	50	56	77	94	94	91	88	83	80	80	80
AB- 47	60	141	132	105	102	82	76	42	43	33	23	10
ASH- 3	1,300	23	23	23	22	22	22	21	21	21	20	20
CH-47C	2,000	70	96	133	189	231	233	232	232	231	228	228
HH- 3	825	36	40	40	40	39	39	39	37	37	37	33
S- 61	1,300	2	2	2	4	8	8	8	8	8	8	8
SH- 3	1,300	10	10	11	15	21	21	21	20	20	20	20
Total Agusta		1261	1339	1412	1491	1506	1484	1412	1361	1342	1316	1287

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price	Actual 1976	FORECAST									
Bell	(000's 1976$)	Inventory	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AH-1	$1,300	838	766	690	612	539	541	537	534	530	532	524
AH-1S	1,500	123	224	316	430	643	652	664	662	659	657	653
AH-1T	3,900	6	8	22	45	57	57	57	56	56	56	55
CH-118	516	8	8	8	7	7	7	6	5	4	0	0
COH58(CH136)	118	65	65	63	63	63	60	56	56	54	50	50
CUH-1(CH135)	365	30	30	30	28	28	26	26	26	25	25	24
HH-1	365	49	48	47	42	36	28	20	18	10	8	0
OH-13	50	26	24	22	20	20	14	12	8	0	0	0
OH-58	118	2048	2040	2034	2030	2020	2015	2010	2000	1995	1990	1985
OH-58A	118	0	0	10	10	10	10	10	9	9	9	9
OH-58B	135	12	21	30	30	30	30	29	28	28	28	27
TH-1	2,300	94	93	92	90	88	86	84	79	64	63	62
TH-57	117	36	36	35	35	34	34	32	30	28	26	26
UH-1	715	846	847	839	833	824	814	805	791	779	766	758
UH-1H	715	3729	3779	3859	3910	3922	3931	3926	3868	3825	3820	3806
UH-1N	1,730	235	256	265	261	260	260	258	258	257	256	252
204	365	2	2	2	2	1	1	0	0	0	0	0
205	650	15	17	16	15	15	14	14	14	13	12	11
206	185	68	67	65	66	65	63	60	56	55	55	55
212	905	32	43	43	42	42	40	40	36	34	34	33
214	525	5	5	5	5	4	4	4	3	3	3	3
214A	165	132	232	293	293	293	290	290	288	288	286	284
214C	600	1	30	39	39	39	39	38	38	38	38	37
47	65	382	349	299	223	171	137	108	83	58	41	29
214C Bell-Iran	1,200	0					48	96	144	198	246	294
Total Bell		8782	8990	9124	9131	9211	9201	9182	9090	9010	9001	8977

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Boeing Vertol												
ACH-47	$2,100	4	4	4	3	3	3	3	2	2	2	1
CH-113	790	9	9	9	9	8	8	8	7	7	6	6
CH-46	790	347	347	346	346	342	340	338	269	200	130	110
CH-47	3,100	270	269	268	267	265	261	260	257	255	252	248
CH-47C	3,100	227	244	245	245	245	243	243	241	240	239	237
UH-46	790	16	16	15	15	14	14	14	10	5	5	5
V-107	2,000	13	13	13	13	12	11	11	10	10	9	9
Total Boeing		886	902	900	897	889	880	877	796	719	643	616
CAC												
Total 206	105	32	30	36	45	52	52	52	50	50	50	50
Dornier												
UH-1	262	293	293	292	288	288	288	284	274	246	221	220
Fairchild												
FH-1100	102	33	26	25	19	16	15	12	11	9	6	4
H-23	NA	4	4	4	3	3						
OH-12	NA	1	1	1	1							
OH-23	NA	12	11	9	9	7	6	1				
SL-4	NA	6	6	6	4	2						
UH-12	NA	12	10	6	6	5	3					
Total Fairchild		68	58	51	42	33	24	13				
Fuji												
FB-204	365	149	159	162	165	165	165	164	164	154	163	163
Hindustan												
SA-315	120	87	104	131	148	148	148	147	147	143	143	141
SA-316	200	154	154	154	152	148	147	145	143	135	135	131
Total Hindustan		241	258	285	300	296	295	292	290	278	278	272

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Hughes												
AH-64A	$3,600								16	30	78	126
OH-6	113	465	460	455	450	446	440	436	430	423	419	414
TH-55	35	636	629	618	616	607	586	565	553	523	486	458
269A	25	3	3	3	3	2	0	0	0	0	0	0
300	58	29	28	28	25	24	18	17	9	7	6	5
500	175	18	20	19	18	18	17	17	16	15	15	14
500MD	175	64	72	70	93	129	146	168	190	188	186	185
Total Hughes		1215	1212	1193	1205	1226	1207	1203	1214	1186	1190	1202
Kaman												
HH-43	470	45	42	40	39	32	24	18	14	10	4	4
SH-2	850	94	94	93	93	92	92	90	86	84	82	82
Total Kaman		139	136	133	132	124	116	108	100	94	86	86
Kamov												
KA-25	NA	9	9	8	8	8	8	7	7	7	7	6
KA-26	84	2	2	2	2	1	1	1	0	0	0	0
Total Kamov		11	11	10	10	9	9	8	7	7	7	6
Kawasaki												
KB-47	50	44	23	18	13	11	10	6	4	0	0	0
KH-4	NA	4	4	3	3	3	1	1	1	1	1	0
KV-107	1,266	114	120	121	121	119	115	115	113	112	109	108
OH-6J	110	109	121	131	141	151	151	150	149	149	148	147
TH-55	35	7	10	10	10	10	10	9	9	9	8	8
Total Kawasaki		278	278	283	288	294	287	281	276	271	266	263
MBB												
BO-105	450	39	42	42	42	42	41	41	38	38	37	37
PAH-1	450	0	0	0	4	26	52	78	146	218	304	336
VBH	450	0	0	0	18	54	90	126	174	212	227	227
Total MBB		39	42	42	64	122	183	245	358	468	568	600

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Meridionali												
AB-47	$ 45	90	90	86	86	86	76	76.	50	30	20	0
Mil												
MI-1	NA	7	4	3	2	0	0	0	0	0	0	0
MI-4	260	247	224	216	208	194	180	165	132	114	98	83
MI-6	2200	42	34	33	30	29	25	22	20	14	10	8
MI-8	600	228	245	242	232	227	215	198	188	162	146	134
Total Mil		524	507	494	472	450	420	385	340	290	254	225
Mitsubishi												
S-61	630	4	5	6	6	6	6	6	6	5	5	5
S-62	370	17	17	17	15	15	14	13	11	11	9	9
SH-3	5,000	57	57	57	56	56	55	54	54	53	53	50
SH-3B	5,000	0	0	4	16	24	24	24	24	24	24	23
Total Mitsubishi		78	79	84	93	101	99	97	95	93	91	87
PADC												
BD-105	450	0	0	0	6	18	33	33	13	33	33	33
RACA												
500	110	5	8	8	27	38	38	38	38	35	33	33

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Sikorsky												
CH-3	$ 825	49	49	49	49	49	48	48	48	48	46	42
CH-34	NA	32	18	18	17	17	15	15	11	9	9	9
CH-53	2,500	224	222	221	223	220	220	215	214	212	208	205
CH-53E	10,300	3	6	9	9	19	33	47	61	70	70	70
CH-53G	2,500	8	10	12	12	12	12	12	12	12	11	11
CH-54	2,105	73	73	73	72	72	71	71	70	70	70	69
CHSS-2(S-61)	755	35	35	34	34	34	34	32	32	32	30	30
H-19	180	2	1	0	0	0	0	0	0	0	0	0
H-34	NA	17	15	14	12	9	5	5	4	4	3	2
HH-3	1,000	88	87	89	95	92	91	90	86	85	81	76
HH-52	215	67	67	64	64	63	63	60	55	50	45	45
HH-53	4,700	41	41	45	51	51	50	50	50	50	49	48
RH-3	2,800	8	8	8	8	7	7	7	7	6	6	6
RH-53	2,800	29	33	39	38	42	44	49	49	47	46	46
S-55	156	22	21	20	18	17	13	10	6	5	3	3
S-58	248	24	17	13	12	11	11	10	10	9	8	8
S-61	800	50	58	72	71	70	69	68	67	65	64	63
S-61NR	1,600	3	3	3	3	2	2	2	2	1	1	0
S-62	370	1	1	1	1	1	1	1	1	1	0	0
S-65	1,700	17	17	17	16	15	15	15	13	13	12	12
S-76	875	0	2	4	4	4	4	4	4	3	3	3
SH-3	1,300	225	235	234	234	232	230	229	227	224	221	219
SH-3D	1,300	0	0	3	7	7	7	7	7	7	7	7
SH-34	NA	3	2	1	0	0	0	0	0	0	0	0
UH-19	180	91	78	72	63	50	38	34	28	21	14	12
UH-60A	2,900	0	0	15	39	213	411	603	790	978	1170	1183
VH-3	1,300	10	10	10	10	9	9	9	9	8	8	8
Total Sikorsky		1122	1109	1140	1162	1318	1503	1693	1863	2030	2185	2177

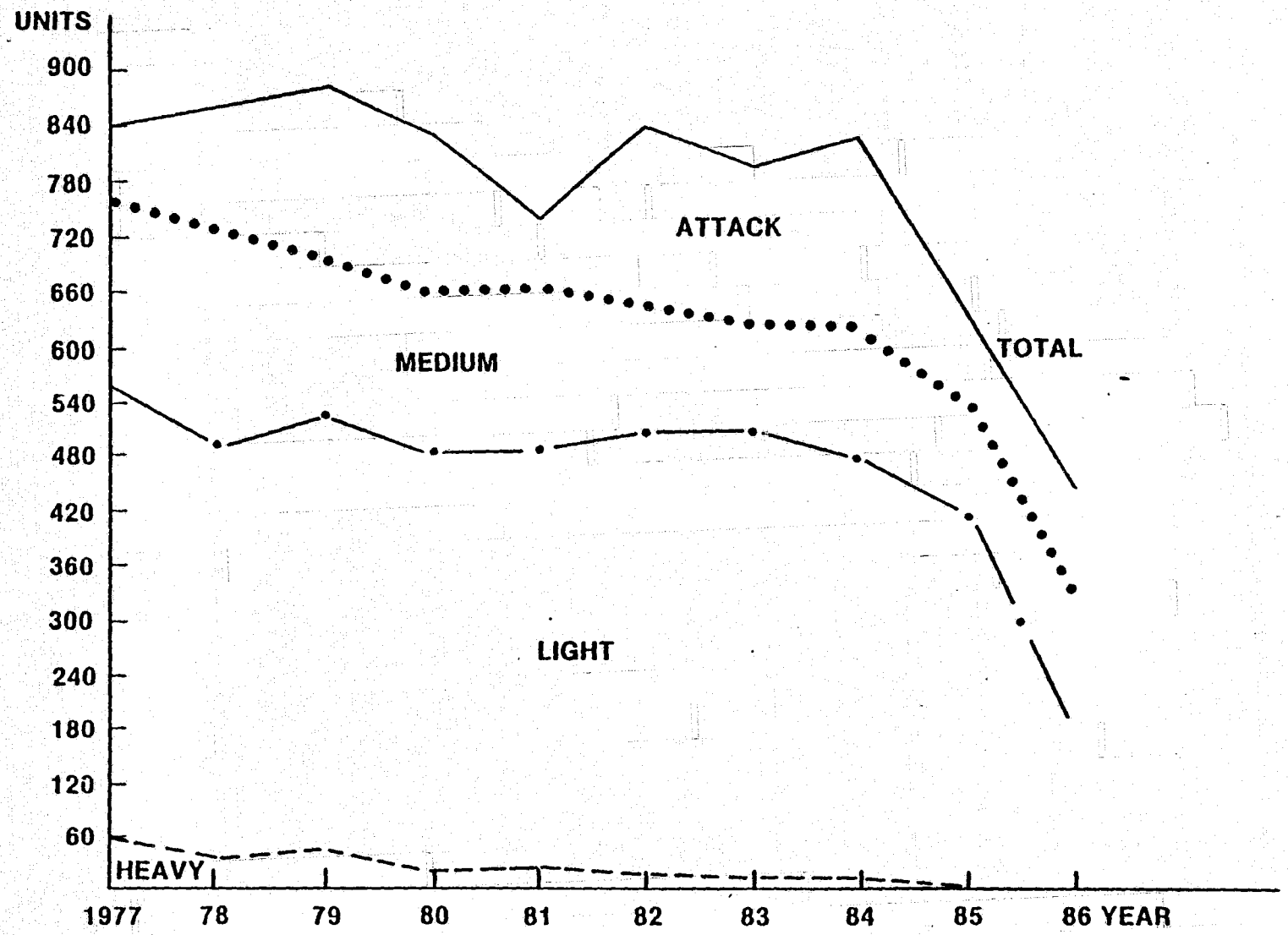
TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Taiwan Bell												
TB-205	$ 365	104	118	117	116	115	114	113	112	111	110	109
Undetermined												
Advance Attack Helo.	NA	0	0	0	0	0	0	0	48	104	212	248
Undetermined												
Heavy Helo.	NA	0	0	0	6	6	7	8	8	20	31	31
Undetermined												
Light Helo.	NA	0	0	65	171	292	445	582	696	832	943	1099
Undetermined												
Medium Helo.	NA	0	0	0	28	83	184	334	530	700	855	997
Total Undetermined		0	118	182	321	496	750	1037	1394	1767	2151	2484
VFW												
CH-53G	2,500	108	108	106	106	102	100	96	90	86	82	82
Westland												
Commando MK1	1,500	5	5	5	5	5	5	4	4	4	4	4
Commando MK2	1,500	0	0	6	12	23	23	23	23	23	23	22
Commando VIP	2,000	0	0	2	2	2	2	2	2	2	2	2
Lynx	800	6	36	83	133	225	289	315	328	326	324	321
Scout	213	112	102	95	60	30	20	0	0	0	0	0
Sea King	2,000	122	136	161	171	173	174	170	169	166	166	162
Sioux	43	120	100	50	0	0	0	0	0	0	0	0
Wasp	213	108	106	104	102	99	99	90	68	46	15	14
Wessex	720	239	236	234	226	206	184	173	161	120	77	77
Whirlwind	250	92	75	48	28	19	3	0	0	0	0	0
Total Westland		804	796	788	739	782	799	777	755	687	611	602

TABLE 3.1 (CONT.)

MANUFACTURER	Unit Price ('000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Yugoslavia Government												
SA-341	194	57	107	127	132	132	132	132	130	129	128	128
TOTAL WORLD		18,652	19,201	19,068	19,941	20,372	20,685	20.933	21,085	21,225	21,466	21,620

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.



SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.8. FORECAST OF WORLD MILITARY HELICOPTER PRODUCTION BY TYPE, 1977-86 (UNITS)

TABLE 3.2
DMS FORECAST OF ATTACK, LIGHT, MEDIUM AND HEAVY MILITARY HELICOPTERS

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK HELICOPTER												
Agusta A-109	Projected Users	-	4	8	12	-	-	-	-	-	-	24
Agusta A-129	Projected Users	-	-	-	-	16	8	12	12	12	-	60
Bell AH-1	Committed Users	23	5	6	4	2	-	-	-	-	-	40
Bell AH-1S	Committed Users	60	93	103	97	12	16	-	-	-	-	381
Bell AH-1T	Committed Users	2	14	23	12	-	-	-	-	-	-	51
Hindustan Adv Atk Helo	Committed Users	-	-	-	-	-	12	18	18	18	24	90
Hughes AH-64A	Committed Users	-	-	-	-	-	16	14	48	48	56	182
Hughes 500 MD	Committed Users	-	12	14	14	24	26	-	-	-	-	90
Hughes 500 MD	Projected Users	-	6	12	12	-	-	-	-	-	-	30
MBB PAH-1	Committed Users	-	4	10	14	14	48	48	-	-	-	138
MBB PAH-1	Projected Users	-	-	12	12	12	20	24	24	-	-	104
Undetermined Adv Atk Helo	Future Requirements	-	-	-	-	-	48	56	108	36	36	284
1. Total Committed Users		85	128	156	141	52	118	80	66	66	80	972
2. Total Projected Users		-	10	32	36	28	28	36	36	12	-	218
3. Total Future Requirements		-	-	-	-	-	48	56	108	36	36	284
Total Attack Helicopter Market (1+2+3)		85	138	188	177	80	194	172	210	114	116	1,474
Total Committed & Projected (1+2)		85	138	188	177	80	146	116	102	78	80	1,190
Total Projected & Future Req. (2+3)		-	10	32	36	28	76	92	144	48	36	502
LIGHT HELICOPTER												
Aerospatiale SA-315	Committed Users	6	-	-	-	-	-	-	-	-	-	6
Aerospatiale SA-316	Committed Users	10	4	-	-	-	-	-	-	-	-	14
Aerospatiale SA-319	Committed Users	3	2	-	-	-	-	-	-	-	-	5
Aerospatiale SA-341	Committed Users	61	64	38	18	-	-	-	-	-	-	181
Aerospatiale SA-342	Committed Users	8	16	12	4	-	-	-	-	-	-	40
Aerospatiale SA-342	Projected Users	-	6	6	6	6	-	-	-	-	-	24
Bell OH-58A	Committed Users	-	10	-	-	-	-	-	-	-	-	10
Bell OH-58B	Committed Users	9	9	-	-	-	-	-	-	-	-	18
Hindustan SA-315	Committed Users	27	27	-	-	-	-	-	-	-	-	54
Hughes 500	Committed Users	8	-	-	-	-	-	-	-	-	-	8
Kawasaki OH-6J	Committed Users	10	10	10	-	-	-	-	-	-	-	30
Kawasaki TH-55	Committed Users	7	-	-	-	-	-	-	-	-	-	7
MBB BO-105	Committed Users	3	-	-	-	-	-	-	-	-	-	3
PADC BO-105	Committed Users	-	-	6	12	15	-	-	-	-	-	33
RACA 500	Committed Users	-	7	-	-	-	-	-	-	-	-	7
RACA 500	Projected Users	-	-	-	12	-	-	-	-	-	-	12
Undetermined Lt Helo	Future Requirements	-	61	96	118	156	140	116	140	122	153	1,102
Yugoslavia Govt. SA-341	Committed Users	50	20	5	-	-	-	-	-	-	-	75
1. Total Committed Users		202	169	71	34	15	-	-	-	-	-	491
2. Total Projected Users		-	6	6	18	6	-	-	-	-	-	36
3. Total Future Requirements		-	61	96	118	156	140	116	140	122	153	1,102
Total Light Helicopter Market (1+2+3)		202	236	173	170	177	140	116	140	122	153	1,629
Total Committed & Projected (1+2)		202	175	77	52	21	-	-	-	-	-	527
Total Projected & Future Req. (2+3)		-	67	102	136	162	140	116	140	122	153	1,138

TABLE 3.2 (CONT.)

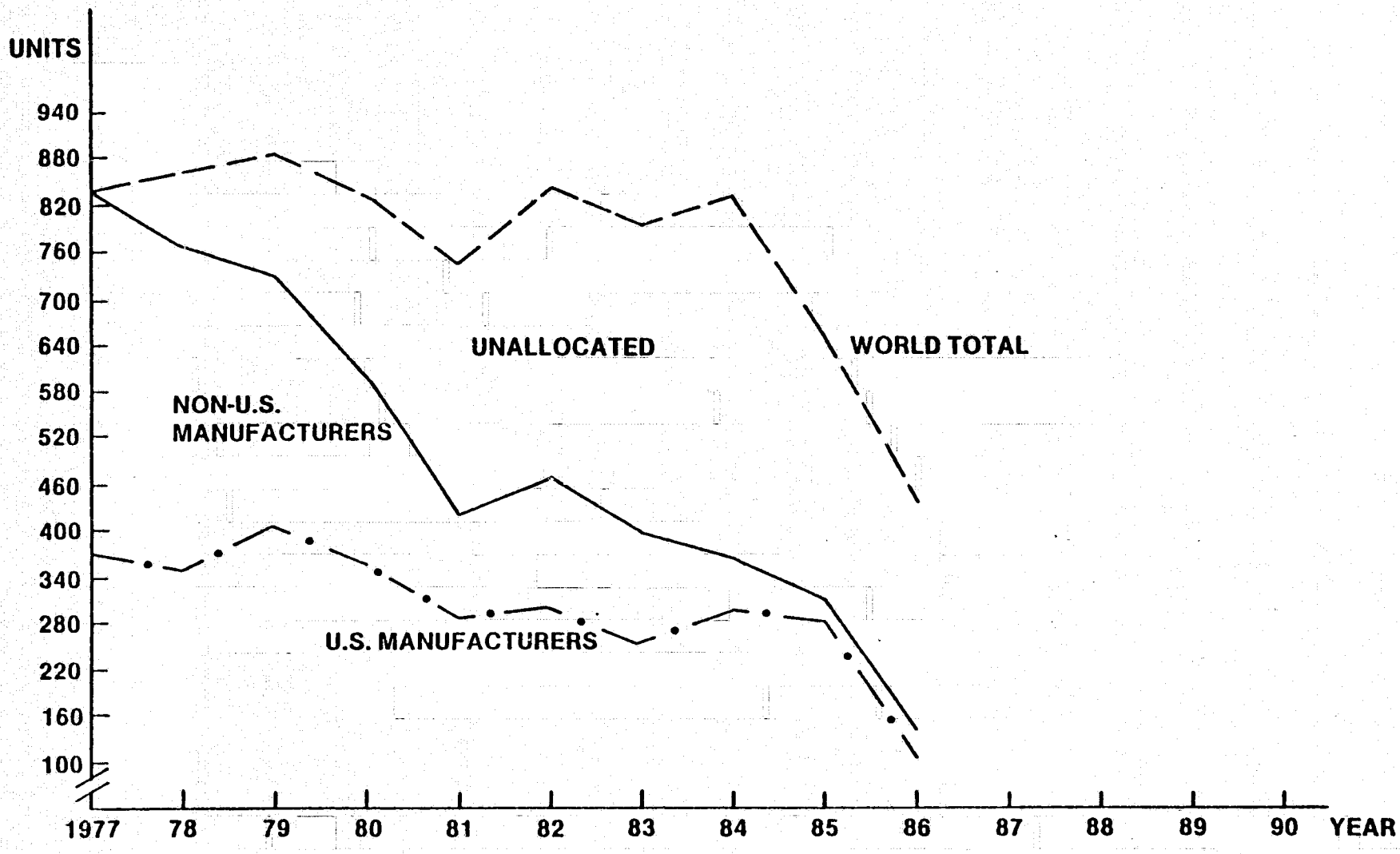
MEDIUM HELICOPTER												
Aerospatiale SA-321	Committed Users	20	16	24	30	-	-	-	-	-	-	90
Aerospatiale SA-330	Committed Users	52	50	16	11	-	-	-	-	-	-	129
Agusta AB-205	Committed Users	42	14	-	-	-	-	-	-	-	-	56
Agusta AB-206	Committed Users	18	23	-	-	-	-	-	-	-	-	41
Agusta AB-212	Committed Users	12	6	-	-	-	-	-	-	-	-	18
Agusta AB-212	Projected Users	-	17	17	-	-	-	-	-	-	-	34
Agusta HH-3	Committed Users	4	-	-	-	-	-	-	-	-	-	4
Agusta S-61	Projected Users	-	2	4	-	-	-	-	-	-	-	6
Agusta SH-3	Projected Users	-	2	4	6	-	-	-	-	-	-	12
Bell UH-1	Committed Users	3	-	-	-	-	-	-	-	-	-	3
Bell UH-1H	Committed Users	46	62	31	4	-	-	-	-	-	-	143
Bell UH-1H	Projected Users	-	12	24	-	-	-	-	-	-	-	36
Bell UH-1N	Committed Users	21	12	-	-	-	-	-	-	-	-	33
Bell 206	Committed Users	-	1	1	-	-	-	1	1	-	-	4
Bell 212	Committed Users	12	-	-	-	-	-	-	-	-	-	12
Bell 214A	Committed Users	100	61	-	-	-	-	-	-	-	-	161
Bell 214C	Committed Users	29	9	-	-	-	-	-	-	-	-	38
Bell-Iran 214C	Projected Users	-	-	-	-	38	38	48	54	48	48	274
CAC 206	Committed Users	6	10	8	-	-	-	-	-	-	-	24
Fuji FB-204	Committed Users	3	3	-	-	-	-	-	-	-	-	6
MBB VBH	Committed Users	-	18	36	36	36	48	38	15	-	-	227
Mitsubishi S-61	Committed Users	1	-	-	-	-	-	-	-	-	-	1
Mitsubishi SH-3B	Committed Users	4	12	8	-	-	-	-	-	-	-	24
Sikorsky HH-3	Committed Users	4	6	-	-	-	-	-	-	-	-	10
Sikorsky S-61	Committed Users	14	-	-	-	-	-	-	-	-	-	14
Sikorsky S-76	Committed Users	2	-	-	-	-	-	-	-	-	-	2
Sikorsky SH-3D	Committed Users	6	8	-	-	-	-	-	-	-	-	14
Sikorsky UH-60A	Committed Users	15	24	156	180	180	180	180	180	180	-	1,275
Sikorsky UH-60A	Projected Users	-	-	18	18	10	8	12	12	4	6	88
Undetermined Med Helo	Future Requirements	-	26	58	108	162	189	214	205	183	118	1,263
Westland Commando Mk 2	Committed Users	6	6	11	-	-	-	-	-	-	-	23
Westland Commando VIP	Committed Users	2	-	-	-	-	-	-	-	-	-	2
Westland Lynx	Committed Users	52	30	58	73	33	30	-	-	-	-	276
Westland Lynx	Projected Users	-	14	4	-	6	-	2	-	-	-	26
Westland Sea King	Committed Users	25	10	2	2	-	-	-	-	-	-	39
1. Total Committed Users		499	381	351	336	149	258	219	196	180	-	2,669
2. Total Projected Users		-	47	71	24	54	46	62	66	52	54	476
3. Total Future Requirements		-	26	58	108	162	189	214	205	183	118	1,263
Total Medium Helicopter Market (1+2+3)		499	454	480	468	465	493	495	467	415	172	4,408
Total Committed & Projected (1+2)		499	428	422	360	303	304	281	162	232	54	3,145
Total Projected & Future Req. (2+3)		-	73	129	132	216	235	276	271	235	172	1,739

TABLE 3.2 (CONT.)

HEAVY HELICOPTER

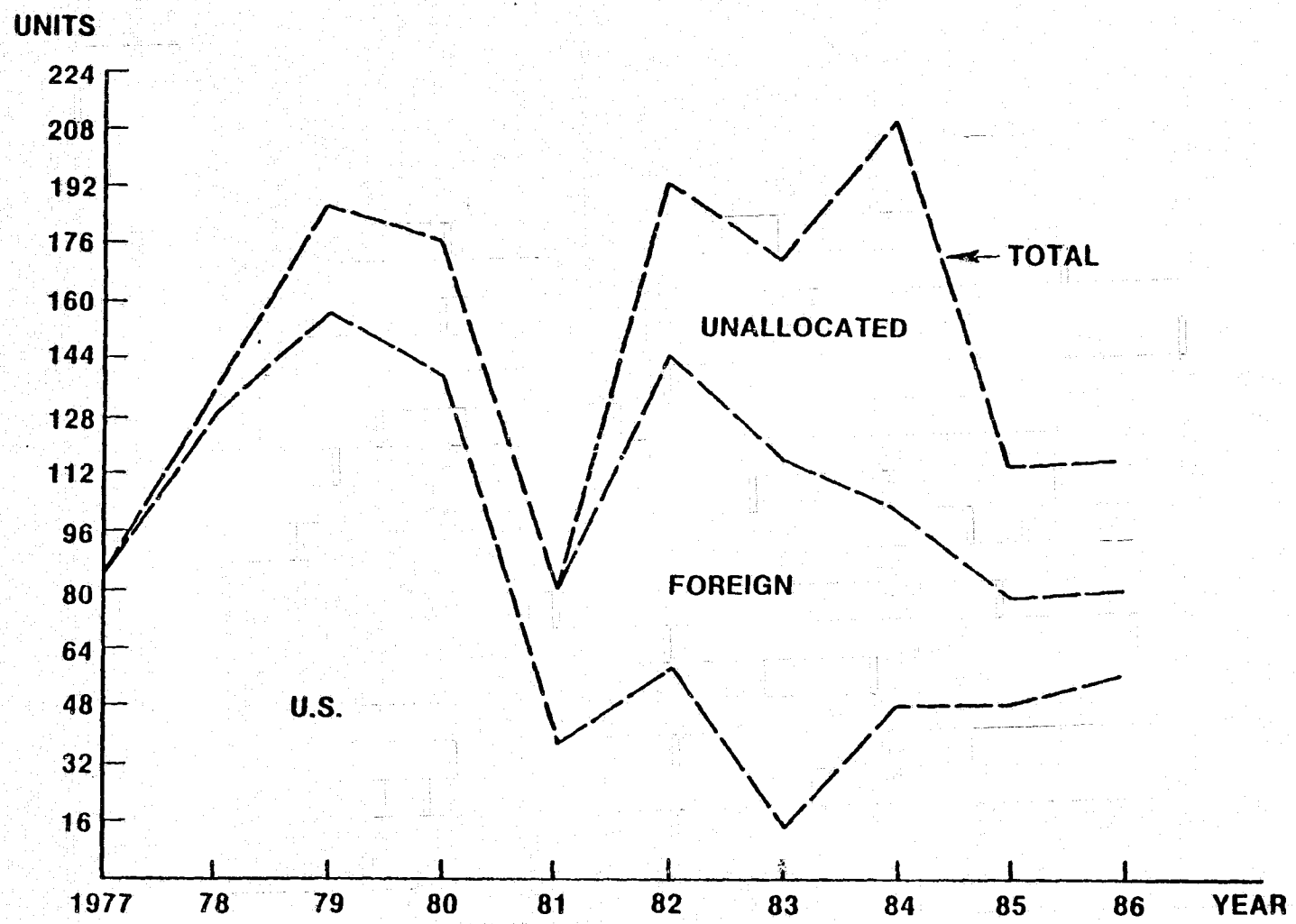
Agusta CH-47C	Committed Users	33	26	28	-	-	-	-	-	-	-	87
Boeing Vertol CH-47C	Committed Users	8	1	-	-	-	-	-	-	-	-	9
Kawasaki KV-107	Committed Users	7	-	-	-	-	-	-	-	-	-	7
Sikorsky CH-53	Committed Users	-	2	2	-	-	-	-	-	-	-	4
Sikorsky CH-53E	Committed Users	3	-	10	14	14	14	-	-	-	-	55
Sikorsky RH-53	Committed Users	6	-	-	-	-	-	-	-	-	-	6
Sikorsky RH-53	Projected Users	-	-	4	2	6	-	-	-	-	-	12
Undetermined Hvy Helo	Future Requirements	-	6	-	1	1	-	12	12	-	-	32
1. Total Committed Users		57	29	40	14	14	14	-	-	-	-	168
2. Total Projected Users		-	-	4	2	6	-	-	-	-	-	12
3. Total Future Requirements		-	6	-	1	1	-	12	12	-	-	32
Total Heavy Helicopter Market (1+2+3)		57	35	44	17	21	14	12	12	-	-	212
Total Committed & Projected (1+2)		57	29	44	16	20	14	-	-	-	-	180
Total Projected & Future Req. (2+3)		-	6	4	3	7	-	12	12	-	-	44

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.



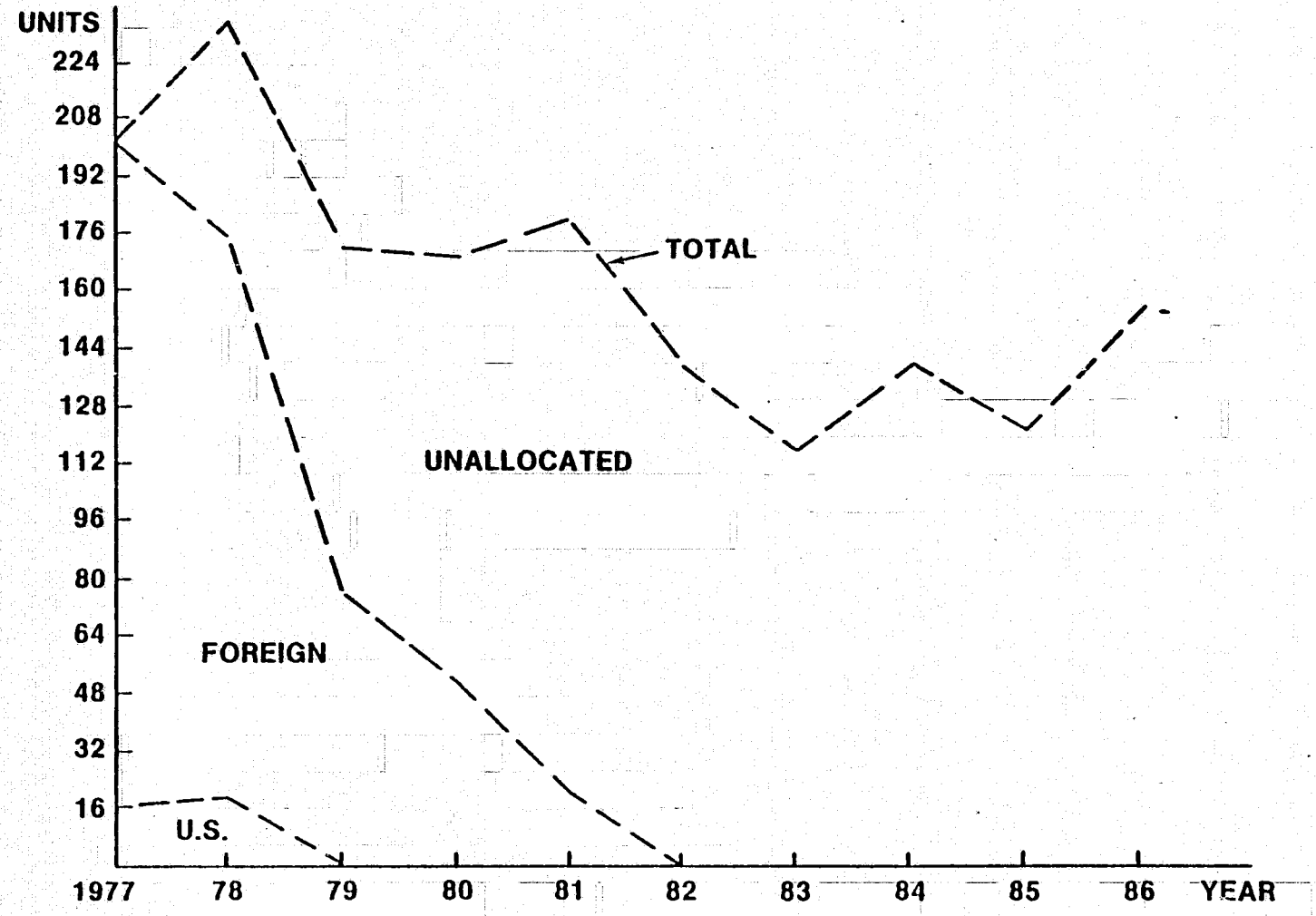
SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.9. WORLD MILITARY HELICOPTER PRODUCTION FORECAST, 1977-86 (UNITS)



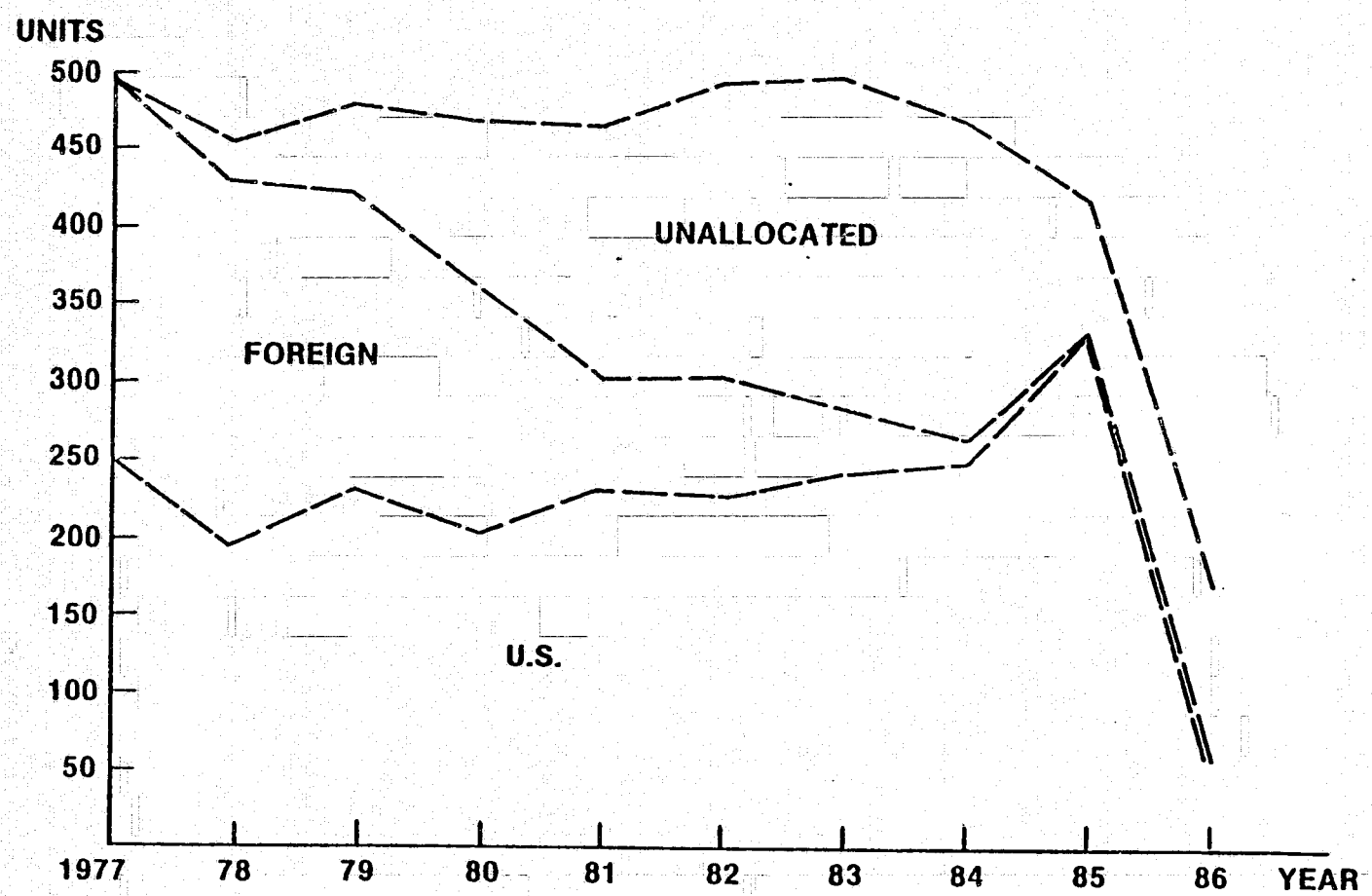
SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.10. WORLD FORECAST FOR MILITARY ATTACK HELICOPTER PRODUCTION, 1977-86 (UNITS)



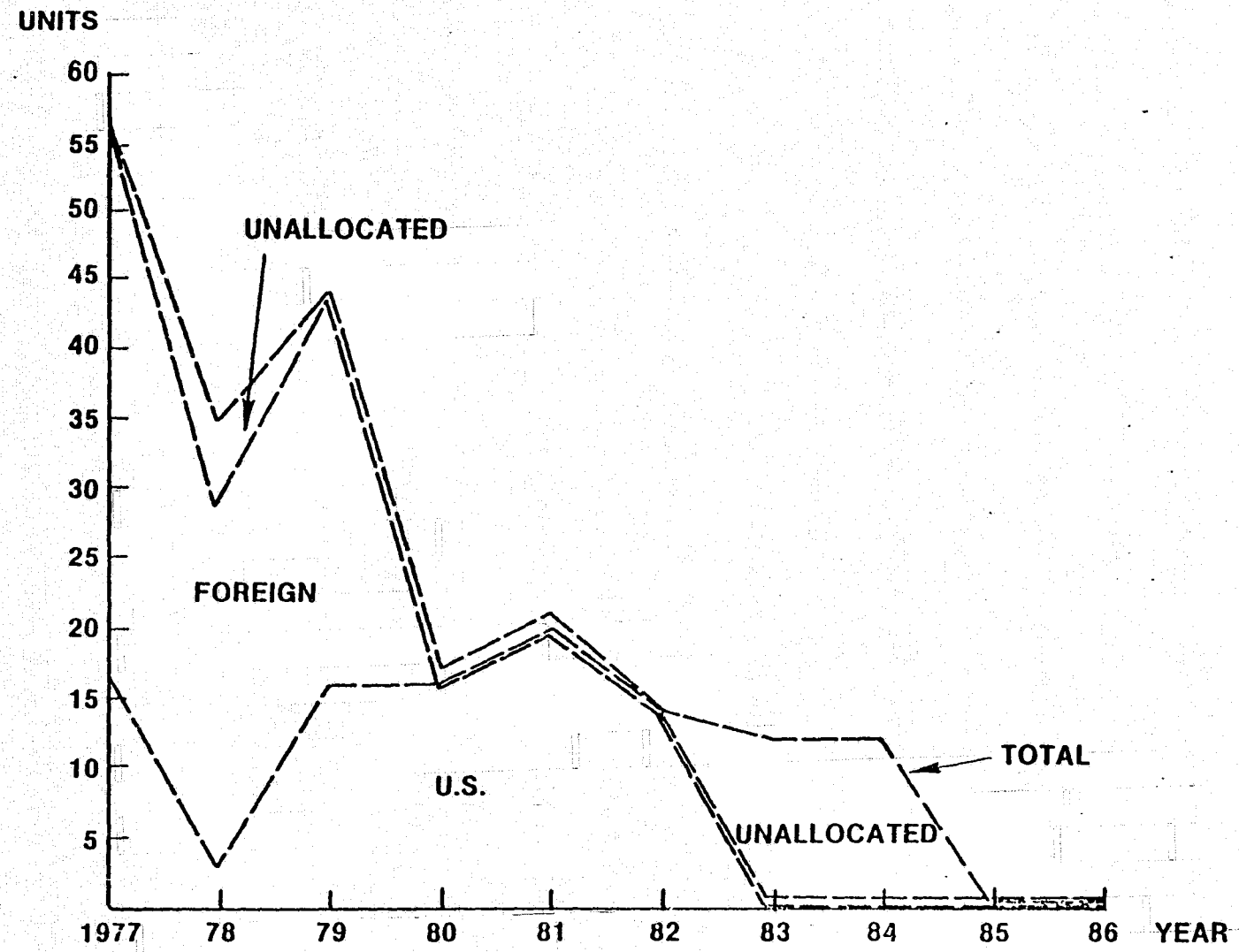
SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.11. WORLD FORECAST FOR MILITARY, LIGHT HELICOPTER PRODUCTION, 1977-86 (UNITS)



SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.12. WORLD FORECAST FOR MILITARY, MEDIUM HELICOPTER PRODUCTION, 1977-86 (UNITS)



SOURCE: DEFENSE MARKETING SERVICES, WORLD AIRCRAFT FORECAST TO 1986 (GREENWICH, CT.: DMS, INC.), 1977.

FIGURE 3.13. WORLD FORECAST FOR MILITARY, HEAVY HELICOPTER PRODUCTION, 1977-86 (UNITS)

IV. EMPLOYMENT

The employment levels of major U.S. and foreign helicopter manufacturers are compared in Figure 4.1 for a three-year period (1974-77). During this period only Westland and Bell showed significant increases. However, nearly 900 Westland employees have been laid off since these figures were published. This was due primarily to slower than anticipated sales of Westland's Sea King. Cutbacks in orders for component parts used in Aerospatiale's Gazelle and Puma also contributed.

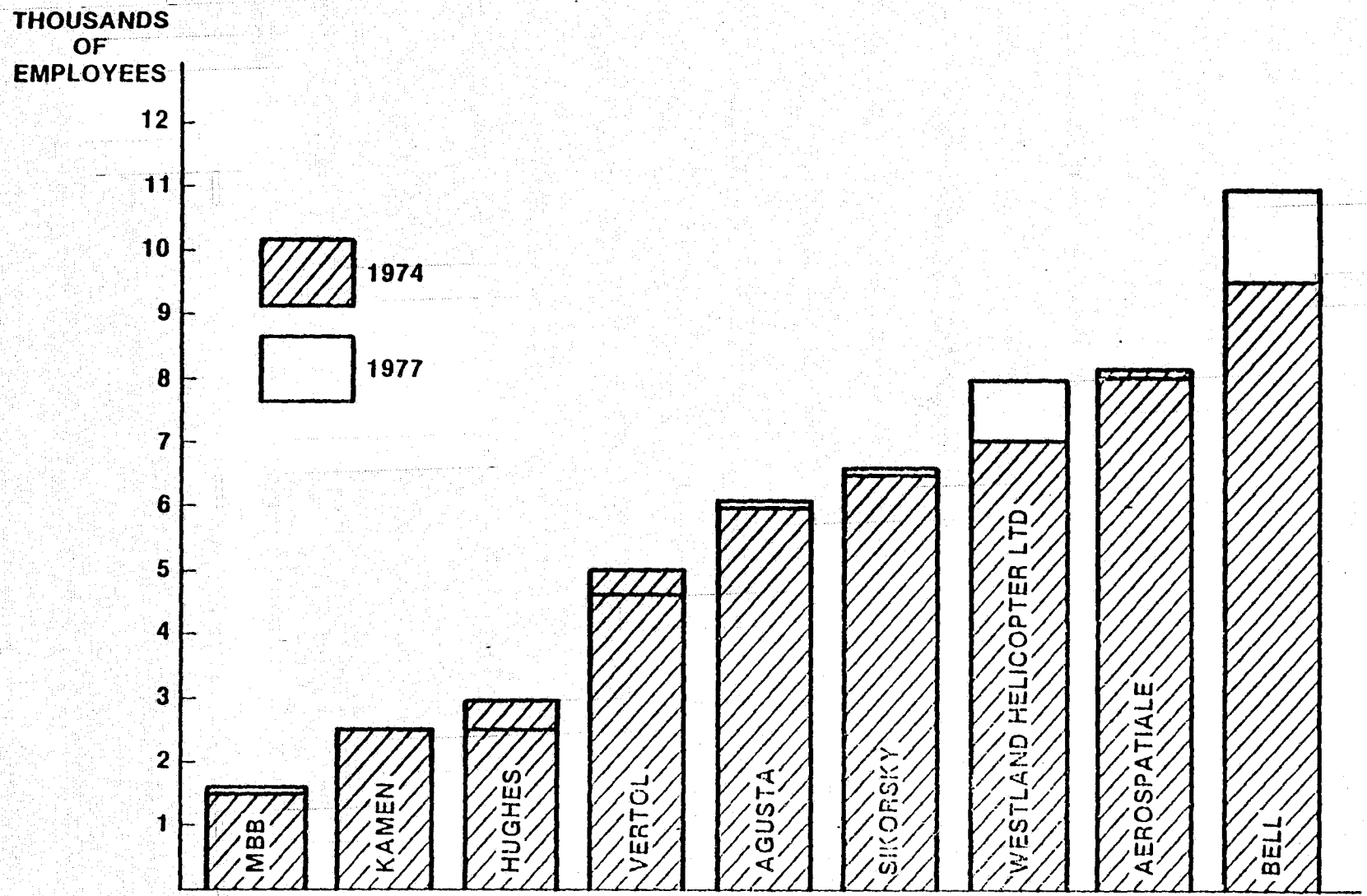
The figure shows that Aerospatiale's 1977 employment was slightly down in its helicopter division from its 1974 total. It is expected to rally in 1978 to approximately 9,000 employees (including 135 in their facility in Texas).

Sikorsky's employment is expected to rise to 10,000 persons by 1985. Its previous high was 11,307 employees in 1957.

Agusta's employment is anticipated to rise to 7,500 persons in 1978.

Boeing Vertol's employment total was down from its 1974 level. Its total employment is expected to decline to 3,800 people during 1978.

Hughes Helicopters' employment was off in 1977 by about 500 people from its 1974 level. In the last ten years Hughes employment had a peak and trough of 5,500 people in 1969 and 1,200 employees in 1973, respectively.



SOURCES: [a] "EUROPEAN PROSPECTS IN THE HELICOPTER FIELD," INTERAVIA, JULY 1976.

[b] AEROSPATIALE HÉLICOPTÈRES, AEROSPATIALE, 1977.

[c] AVIATION WEEK AND SPACE TECHNOLOGY, VARIOUS ISSUES.

[d] ANN N. DAVIS AND ROBERT A. RICHARDSON, THE HELICOPTER: ITS IMPORTANCE TO COMMERCE AND TO THE PUBLIC (WASHINGTON, D.C.: HELICOPTER ASSOCIATION OF AMERICA), MARCH, 1978.

FIGURE 4.1. COMPARISON OF EMPLOYMENT LEVELS MAJOR HELICOPTER MANUFACTURERS FOR 1974 and 1977

MBB showed a slight increase in employment over the three year program. Kaman remained steady.

Table 4.1 shows employment estimates for an intermediate year, 1975. This table also states that the U.S. share of total helicopter manufacturing employment is 54 percent, while the U.S. share based on the value of helicopter output is only 46 percent. Since the U.S. typically produces more helicopters than the Europeans at prices at least comparable, this implies that U.S. helicopter manufacturing employees are being surpassed in individual productivity by their European counterparts.

TABLE 4.1

EMPLOYMENT ESTIMATES FOR MAJOR HELICOPTER MANUFACTURERS

European	
Aerospatiale	8200
Agusta	5516
MBB	1500
Westland	7461
Total Europe	22677
U.S.	
Bell	9600
Boeing Vertol	5000
Hughes	3000
Kaman	2500
Sikorsky	6500
Total U.S.	26600
Total U.S. and European Employment	49277
U.S. share based on employment	54%
U.S. share based on value of output	46%

Source: Commission of the European Communities, The European Aerospace Industry Position and Figures, Brussels, Belgium, May, 1977.

V. FOREIGN COMPETITION

INROADS IN THE U.S. MARKET

To date, the U.S. military has not purchased any European-designed helicopters. Figure 2.4 showed that although the number of helicopters imported into the U.S. civil sector is increasing, the rate is increasing at the same rate as U.S. civil exports. In 1977, approximately 50 helicopters were imported and nearly 350 were exported by the U.S., from a total U.S. civil production of approximately 800 helicopters. The open literature assimilated in the performance of this study identified three classes of civil helicopter competition:

Class A pits the Agusta 109A against the Bell 222. Class B teams Aerospatiale's SA 341 Gazelle and the stretched Gazelle against the Bell 206B + Jet Ranger 111. Finally, Class C matches Aerospatiale's SA 360C/365C Dauphin and Dauphin 2 against the following helicopters:

- Agusta 109A
- Bell 222
- Sikorsky S-76
- Westland 606.

Based on parameters shown in Table 5.1, the following points of comparison can be made:

1. Class A: The Agusta 109A exhibits a greater maximum cruise speed and is approximately twice as fuel efficient as the Bell 222.

2. Class B: In this single-engine, five passenger competition, the Aerospatiale Gazelles have a 17 percent greater maximum cruise speed and a 10 percent greater range than the Bell Jet Ranger. The Bell 206B is more fuel efficient and has a greater useful load per purchase price than the Gazelles.

3. Class C: Although no information was available on the Westland 606, the following comparative points were made:

   - The maximum cruise speed of the Agusta 109A was slightly higher than those quoted for the other helicopters
   - The range of the Sikorsky S-76 far exceeded that of the European competitors in its class
   - The Agusta 109A was significantly more fuel efficient than the other class competitors
   - The Aerospatiale SA 360C single engine Dauphin compared surprisingly well with the S-76.

By 1976, Boeing Vertol had sold 50 BO 105's under license production in the U.S. Atlantic Aviation also reportedly had 170 North American orders for the Agusta 109 Hirando.

EUROPEAN MARKET

The European market for both civil and military helicopters should continue to grow into the 1990's. However, U.S. manufacturers should lose their previous share of European civil markets due to the availability of a

TABLE 5.1
SUMMARY OF CIVIL HELICOPTERS

DESIGNATION	PRICE (THOUSANDS OF $)	SEATS	ENGINE	NO. OF ENGINES	GROSS WEIGHT (LBS)	POWER LOADING (LBS/HP)	MAX CRUISE (KTS)	CLIMB RATE (FPM)	RANGE MAX CRUISE (NM)	MPG MAX CRUISE (NMPG)	USEFUL LOAD / PRICE (LBS / THOUSANDS OF $)	PAYLOAD MAX FUEL / PRICE (LBS / THOUSANDS OF $)	MAX SLING LOAD / PRICE (LBS / THOUSANDS OF $)
Bell 206B Jet Ranger III	208	5	All 250-C20	1	3200	7.6	122	1260	290	4.4	7.5	5.1	7.2
Hughes 500D	210	5	All 250-C20B	1	3000	7.1	140	1900	(NA)	3.9	7.5	5.6	9.5
Aerospatiale SA 341G Gazelle	269	5	Turbomeca Astazou IIIA	1	3970	6.7	142	1338	318	3.1	6.7	3.1	5.7
Aerospatiale AS 350C AStar	277*	5/6	Lyc LTS-101-600A	1	4190	7.1	135	1570	427□	(NA)	7.8	3.6	7.9
Aerospatiale SA 341G Stretched Gazelle	285	5	Turbomeca Astazou III	1	3970	6.7	142	1338	318	3.1	6.3	4.4	5.4
Bell 206L Long Ranger II	310	7	All 250 C20B	1	4000	7.5	113	1530	295	3	6.1	4.0	6.5
Aerospatiale SA 315B Lama	325	5	Turbomeca Artouste IIIB	1	5070	5.9	112	1080	241	2.1	8.6	5.5	7.7
Aerospatiale SA 316B Alouette III	(NA)■	7	Turbomeca Artouste IIIB	1	4850	5.7	101	850	191	1.7	7.3	4.2	5.7
Bell 206L-1 Long Ranger II	335	7	All 250-C20B	1	4050	8.1	113	1530	290	3	5.5	3.6	6.0
MBB BO-105S	525	5	All 250-C20B	2	5070	7.4	132	1600	539	2.4	4.2	0.94	3.8
Giovanni Agusta 109A	595	8	All 250 C20B	2	5400	7.8	150	1600	281	2.5	3.3	1.7	3.4
Aerospatiale SA 360C Dauphin	651	10/14	Turbomeca Astazou XVIIIA	1	6615	6.3	146	1400	338	1.9	4.7	2.5	5.1
Aerospatiale SA 365C Dauphin 2	865**	10/14	Turbomeca Arriel	2	7495	5.9	142	1675	312	1.4	4.8	2.7	3.8
Bell 205A-1	745	15	Lyc T53138	1	9500	6.8	110	1680	270	1.3	5.9	2.4	6.7
Sikorsky S-58T	880	12/16	P & WAC PT6T 6	1	13000	8	124	1300	391	1	6.1	2.8	5.7
Bell 212 Twin	965	15	P & WAC PT6T 3	2	11200	6.2	105	1420	226	1.1	5.5	2.8	5.2
Bell 222	975***	7/10	Lyc LTS 101-650C-2	2	7650	6.5	143	1730	390	1.3	3.2	1.7	4.1
Sikorsky S-76	990	12/13	All 250 C30	2	9700	7.4	145	1400	474	1.6	4.8	2.3	5.1
Bell 214B	1250	16	Lyc T5508D	1	13800	4.7	146	2280	162	0.9▲	4.8	3.7	6.4
Aerospatiale SA 330J Puma	2083	19	Turbomeca Turmo IVC	2	16300	5.2	139	1200	331	0.7	3.8	1.9	3.4
Sikorsky S 61N	3215	26/28	GE CT58 140 2	2	19000	7.6	130	1300	438	0.8	2.8	0.63	2.5

*Price thru 1980, Interavia, 5/1978

**Price supplied by Aerospatiale (1978 Price)

***Price thru 1980, Interavia, 5/1978. Remaining data from Bell 222 Summary Report, January, 1978

▲Given as 9.9 NMPG in Gama Compilation

□ Range Quoted in Aerospatiale Lithograph, 1/78

■ 318 in 1977 Fleet Directory

diverse fleet of European-designed civil helicopters. The U.S. manufacturers may also face stiff competition from Aerospatiale and joint European programs in their attempt to maintain their 20 percent share of the EEC countries' military fleet (Figure 3.4). Certain European political actions impact the U.S. helicopter export market. These will be discussed in subsequent paragraphs.

REST OF THE WORLD MARKET

This market seems to be the real plum in the pie for the next ten to fifteen years since it is larger than the projected European market and considerably more "up for grabs" than either the European or North American markets.

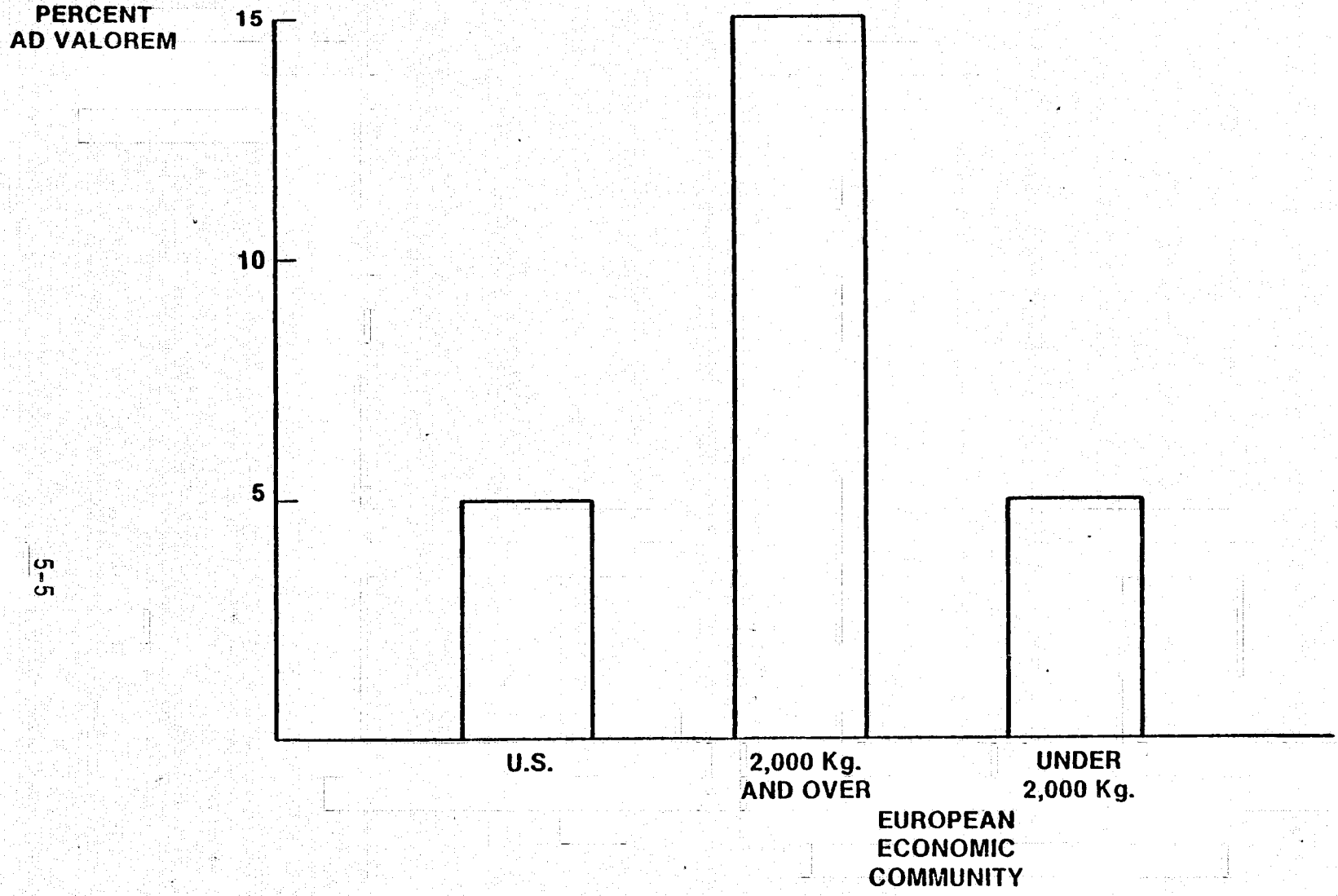
This market consists of the world civil and military helicopter markets outside the U.S. and Europe and excluding Russian and Red China. Recent articles in aviation periodicals suggest that the U.S. has been performing well in this market; however, certain U.S. policies impact the competitive posture of U.S. manufacturers against European manufacturers. Additionally, Aerospatiale exports 80 percent of its production and a large number of these units go to this world market. Consequently it poses formidable competition for U.S. manufacturers, whose combined export units fail to match those of Aerospatiale.

FOREIGN POLICIES IMPACTING U.S. COMPETITION

Four tangible political actions were determined to constrain or potentially impact U.S. competitive posture in foreign helicopter markets. These are:

- import duties
- embassy promotion
- lucrative government financing
- joint development programs.

Figure 5.1 shows the customs duties imposed on civil helicopter imports by the countries of the major producers. There are no customs duties on military imports. The U.S. imposes a charge of 5 percent on the import value. All countries of the European Economic Community (EEC) have agreed to a common external duty based on gross weight. The EEC imposes a charge of 5 percent on the import value of helicopters weighing under 2,000 kilograms (4,409 pounds) and 15 percent on helicopters weighing 2,000 kilograms and over.



SOURCES: U.S. BUREAU OF THE CENSUS, U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS: TARIFF SCHEDULE OF U.S. ANNOTATED, REPORT FT246 (WASHINGTON, D.C.: USGPO), ANNUALLY.

THE EUROPEAN ECONOMIC COMMUNITY, COMMON EXTERNAL DUTIES (BRUSSELS, BELGIUM: EEC).

FIGURE 5.1. CUSTOM DUTIES ON CIVIL HELICOPTER IMPORTS, 1978

Since almost all of the civil helicopters designed by European manufacturers have a gross weight of over 2,000 kilograms, the European manufacturers are receiving considerable protection in their home markets.

Because helicopters are rather expensive items, the customs duty will amount to a sizable dollar figure, e.g., a helicopter costing $400,000 would incur a duty charge of $20,000 at 5 percent or $60,000 at 15 percent. In order for a foreign manufacturer to compete in the U.S. market, his product must be better or he must reduce his price enough below the domestic manufacturers to make up for the customs duty.

The European helicopter manufacturers are aided in the export sales of their helicopters by their embassies throughout the world. This cooperation ranges from outright promotion to easing the prospective customer through necessary red tape. By contrast, U.S. embassies are prohibited from promoting any aerospace products that are military arms or potential military arms.

Recent European air transport sales have been characterized by very lucrative financing arrangements. The Eastern A300 Airbus buy and the Pan Am purchase of L1011's powered by Rolls Royce engines are cases in point. Minimal down payments and long-term financing were underwritten by European governments. This seems to be the European response to the Export-Import bank which has so favorably served U.S. aerospace exports over the years. Whether or not European nations make this lucrative financing available to prospective helicopter purchasers or whether they plan to, is unknown.

The challenge posed by foreign competition is also intensified by advanced development programs. Britain and France joined together in 1967 on the design, development, and production of three major military helicopter programs: the Gazelle, Puma and the Lynx. These joint development programs potentially can result in an advanced technological endproduct due to the pooling of R&D funds. In addition, these joint military programs virtually lock in substantial military orders from the sponsoring countries. The Europeans can embark on joint programs in basic helicopter R&D. This was enacted when the Commission of European Communities prepared an "Action Programme for Aeronautical Research." Subsequently in 1977, a joint European research program in helicopter R&D was proposed.

U.S. POLICIES IMPACTING U.S. COMPETITION

The U.S. Government currently impacts helicopter exports in two ways. They are known as pro rata reimbursement and bureaucratic delay. When exporting U.S.-produced civil helicopters that are military derivatives (all U.S. civil helicopters fall into this category except the Bell 222 and the Sikorsky S-76), the U.S. government levies a surtax on the purchase price. The government recoups this fee as reimbursement of some of the R&D funds spent on the original military development program. Present U.S. foreign policy also causes delays in conducting foreign helicopter sales.

When U.S. civil helicopters are to be exported, the Department of Commerce is involved in reviewing the sale. Similarly, military helicopter exports are reviewed by the Department of State. However, if U.S. civil helicopters are to be purchased by a country, or operators in a country, where human rights violations are alleged, both the Departments of State and Commerce review the sale. These agencies not only cause delays in completing the sales, but they also can veto the export sales. Apparently, neither the criteria used by these agencies to qualify a helicopter export sale, nor the legal authorization for their review functions are clearly specified.

TECHNOLOGICAL REASONS FOR FOREIGN ADVANCES

Any technologically advanced nation (such as the U.S.) aims at supplying a substantial proportion of its domestic markets from domestic sources and aims at as high a share of foreign markets as it can reasonably achieve. This is especially true of military markets, for obvious reasons, and emphasizes that there are strong political and economic pressures tending to influence market developments toward such a pattern.

The U.S. emerged from World War II in a commanding position in both military and civil aviation. For many years, foreign manufacturers of helicopters were heavily dependent on U.S. technology and know-how, and licensing agreements for the manufacture of U.S. designs by foreign manufacturers were common. However, the market forces that shaped U.S. policy over the long term are now operating with less restraint among other well-developed nations, and Governments are satisfying their military requirements increasingly with domestically-designed machines, at the same time seeking to benefit from their

export. Moreover, some European helicopters designed exclusively for the civil market are proving remarkably successful, confirming the importance of developing products tailored to their intended market. Many of the latter machines incorporate some technologically innovative features of high apparent promise.

In the field of advanced technology, France has long been recognized for innovative advances in aviation. The Alouette was the first helicopter to be fitted with a gas turbine engine. A family of Aerospatiale machines is now on the market (the Gazelle, Dauphin, Puma, and more recently the Ecureuil (AStar)) incorporating plastics and composite material rotor blades coupled with design simplification. These machines combine economy of operation with claimed reliability and long life. The popularity of twin-engine foreign designs stems from the additional safety element, and has undoubtedly influenced the two new U.S. machines designed expressly for the civil market - the Bell 222 and Sikorsky S-76.

U.S. emphasis on military helicopter production during the Vietnam War was of some advantage to foreign manufacturers in improving their share of the world civil helicopter market, though such developments would have materialized anyway as the respective national helicopter industries "matured." It is significant that the first two American responses to the civil market situation, the Bell 222 and the Sikorsky S-76, are somewhat heavier and more expensive than the European competition (with the exception of the Puma).

The more recent European helicopters are undoubtedly attractively styled. Other things being equal, a machine with an attractive appearance possesses an obvious sales advantage. Whatever the performance advantages and disadvantages of the "Fenestron" tail rotor, it is a distinctive feature of several Aerospatiale machines, and serves to attract customer attention.

In the long term, markets will go to manufacturers that can offer machines with desirable performance at competitive cost, coupled of course with reliability and servicing support. Table 5.1 provides a comparison of helicopters currently or shortly available in the general aviation market in the U.S. in the 3,000 lb and up category. In addition to initial cost, performance criteria are listed, together with parameters in the last three columns in which carrying capacity is related directly to initial cost. The usual qualifier must be made that data from so many different sources is not necessarily strictly comparable; however, some general inferences may be drawn.

The first and perhaps most obvious fact is that no two machines are directly competitive, as would occur for example if two machines having nearly identical performance were offered at a nearly identical price.

The Aerospatiale machines, the MBB BO-105S, and the Agusta 109A are at least interesting alternatives to the U.S. machines on offer. The modern Aerospatiale machines are fast and attractively priced in spite of the U.S. import duty. The MBB helicopter is twin-engined and has a long range. The Agusta 109A is also a twin, and has the highest cruise speed of all.

The Sikorsky S-76 and Bell 222 are heavier machines than the foreign competition (with the exception of the Puma), although the Dauphin 2 matches the Bell 222 fairly closely on cost and performance. The first U.S. machines designed specifically for civil operations are deliberately aimed at the business and offshore oil markets. It may be anticipated that future U.S. designs will materialize to meet more directly the inroads into civil markets that are being made by the lighter helicopters.

VI. ROTORCRAFT R&D FUNDING

European helicopter R&D funding has been estimated at running about $30-35M annually. These funds result from direct or indirect government subsidies, manufacturers' internal R&D and joint EEC cooperative research programs. No information was available on the magnitude of government subsidies, however Aerospatiale reported that internal R&D amounts to 5-10 percent of helicopter sales. Since helicopters comprise a sizable position of Aerospatiale's business (24 percent of pretax profits) this 5-10 percent share is probably representative of the internal funding of Westland MBB and Agusta as well. Table 6.1 shows summary funding figures for proposed EEC aeronautical research for helicopters and convertible aircraft.

The two primary sources of rotorcraft R&D in the U.S. have been the U.S. Army and NASA. The Army expenditure is geared to development of specific military helicopters with defined missions. This R&D funding seemed to peak at nearly $250M in 1974. NASA funding in basic research and applications technology has increased dramatically in the early to mid-1970's with the procurement of the Rotor Systems Research Aircraft (RSRA) and the Tilt Rotor Research Aircraft (TRRA). These flying testbeds will provide valuable platforms for Rotorcraft R&T well into the 1980's. Finally, Table 6.2 shows the breakdown

of NASA's R&T Base funds for FY 79 and FY 80. The allocation of funding for rotorcraft and other aviation vehicle classes is illustrated.

TABLE 6.1

COMMISSION OF THE EUROPEAN COMMUNITIES
PROPOSED BUDGET FOR AERONAUTICAL
RESEARCH (Millions of Dollars)

YEAR	HELICOPTERS	CONVERTIBLE AIRCRAFT	TOTAL
1977	4.99	--	4.99
1978	5.34	13.51	18.85
1979	3.23	5.60	8.83
1980	3.00	5.60	8.60
1981	1.83	2.79	4.62
TOTAL	18.39	27.50	45.89

Source: Commission of European Communities, Action Programme For Aeronautical Research, July 1977.

TABLE 6.2

NASA - OAST R&T EXPENDITURE FORECASTS BY VEHICLE CLASS

VEHICLE CLASS	FY1979(K$)	PERCENT OF TOTAL	FY1980(K$)	PERCENT OF TOTAL
ROTORCRAFT	18,166	7.2	24,270	9.0
C.T.O.L.	132,435	52.2	143,277	52.9
SUPERSONIC CRUISE	16,455	6.5	14,785	5.5
HYPERSONICS	3,264	1.3	3,364	1.2
S.T.O.L	6,766	2.7	5,285	2.0
V.T.O.L.	5,320	2.1	5,433	2.0
GENERAL AVIATION	9,510	3.7	8,220	3.0
HIGH PERFORMANCE A/C	12,750	5.0	17,261	6.4
GENERIC	48,973	19.3	48,980	18.1
TOTAL	253,639	100.0	270,875	100.0

Source: NASA-OAST, Research and Technology Aeronautics Data Summary, May 1978.

COMMERCIAL AIRCRAFT SHIPMENTS

—— U.S. MFG AIRCRAFT SHIPMENTS
– – – WORLDWIDE AIRCRAFT SHIPMENTS

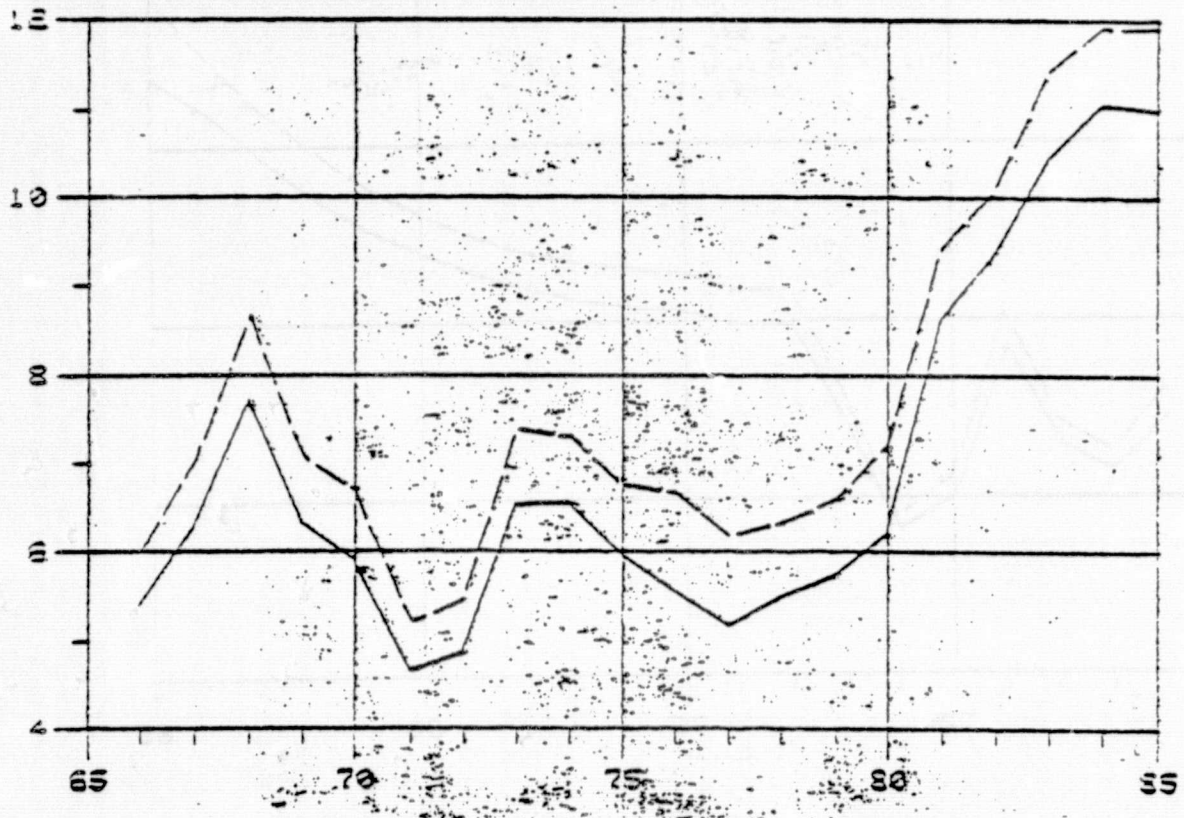


FIGURE 9

COMM HELICOPTER SHIP

COMM HELICOPTERS US MFG SHIPMENTS
COMM HELICOPTERS WORLD SHIPMENTS

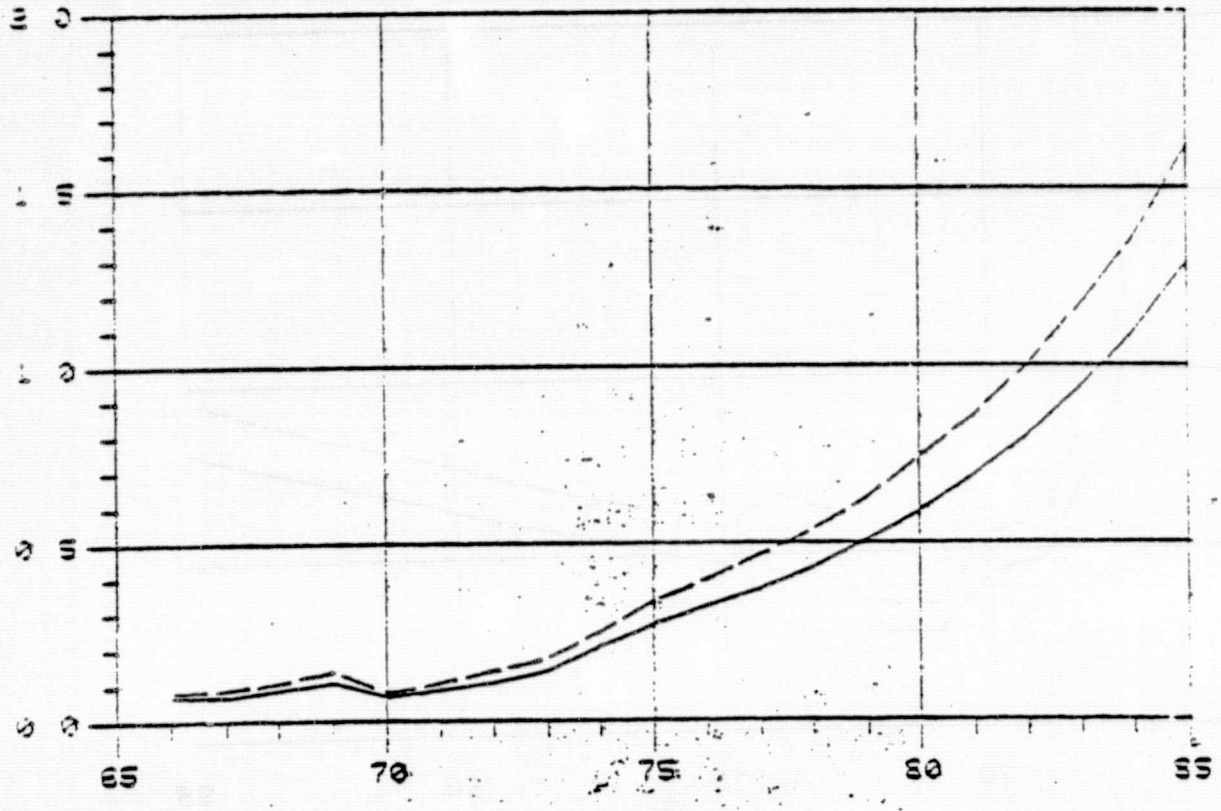


FIGURE 11

AIRCRAFT ENGINE SHIPMENTS

COMM AIRCRAFT ENGINES US MFG SHIPMENTS
COMM AIRCRAFT ENGINES WORLD SHIPMENTS

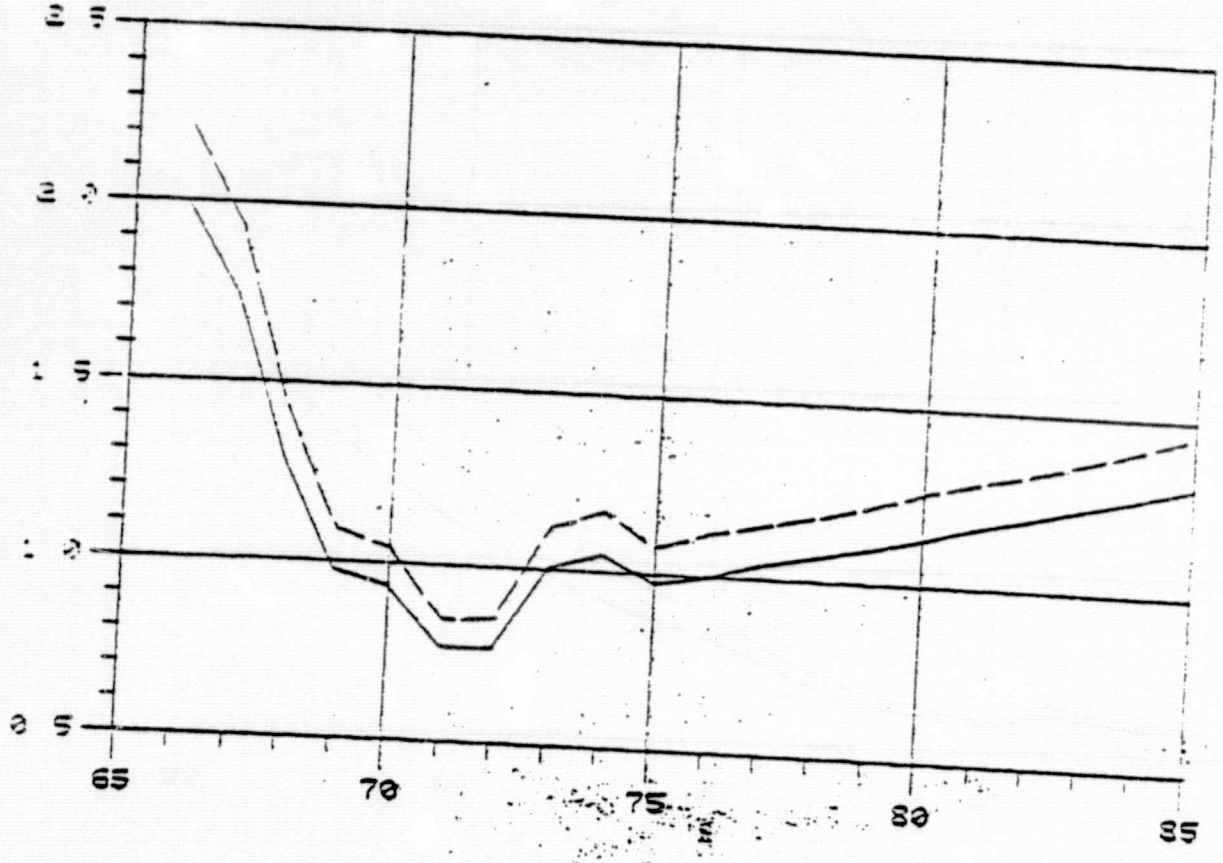


FIGURE 12

COMMERCIAL TRANSPORT SHIP

COMM TRANSPORT AIRCRAFT US MFG SHIPMENTS
COMM TRANSPORT AIRCRAFT WORLD SHIPMENTS

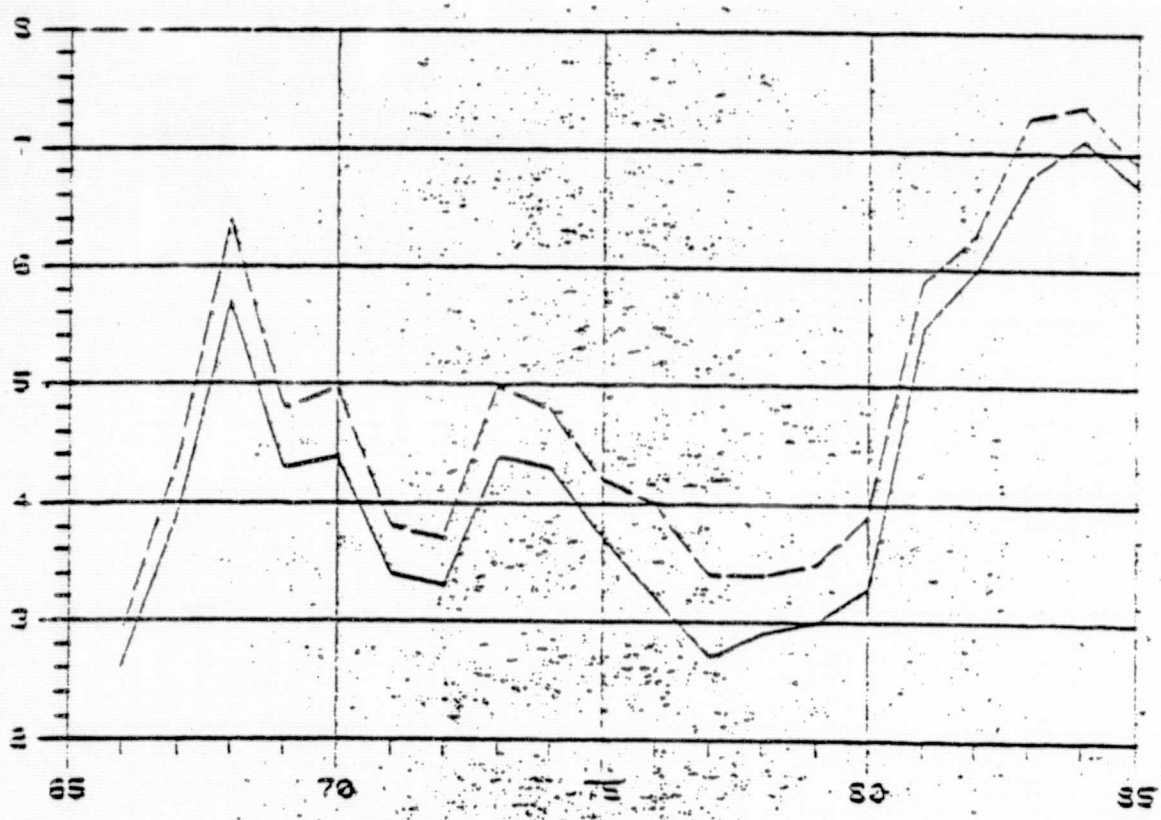


FIGURE 13

VII. SOURCES OF INFORMATION

There seem to be three reliable sources of information on foreign helicopter markets and technology competition. They are the Army's Foreign Science and Technology Center (FSTC), the U.S. manufacturers' task force, and aviation periodicals. Interavia, Flight International and Aviation Week and Space Technology are particularly useful.

Significant market data may be stored on the NASA Aviation Data Base to which OAST and the NASA research centers have on-line access. The data in this data base can be updated and hard copy plots of significant parameters of interest can be outputted. Appendix B consists of a memo which describes the application and utility of the Aviation Data Base for aviation market and trend analyses. ORI developed a user's guide and other documentation which can be made available if the Program Office desires it.

VIII. CONCLUSIONS

While it is desirable to improve the USA position relative to foreign technology and foreign competition, it is necessary to recognize that the advances made by European helicopter manufacturers in particular are the result of a sustained effort to secure a "share" of world markets, and that this effort may be expected to continue into the indefinite future. The market is "maturing," and the realistic objective for the U.S. is to maintain a strong relative position while accepting that the competition is here to stay.

In the technological field, there is no evidence that foreign competition poses a significant threat. Provided funded research continues into innovative applications of new materials, construction techniques, and applications, no disadvantage in this area is likely to surface. American manufacturers are maintaining their lead in developing advanced and reliable machines with a judicious blend of proven techniques and innovation.

The aggressive effort made by Aerospatiale to promote sales of light to medium helicopters in world civil markets bears watching. Provided U.S. manufacturers are prepared to develop machines specifically for the civil market which are somewhat smaller than the Sikorsky S-76 and the Bell 222 as follow-ups to these machines, the future market for the products of U.S. industry does not appear to be threatened.

The Sikorsky compound research aircraft (RSRA) is an excellent example of U.S. technological know-how coupled with an innovative approach to research. It is important that the astute promotion that is proving so successful in marketing European products should be appreciated by U.S. sales personnel in marketing their own machines. The U.S., too, is technologically advanced and more emphasis should be placed on the skill with which such advances are combined into a solid background of experience to develop marketable products.

In one field alone, Europe appears to offer a competitive edge. Europe's helicopters are attractive to look at. As was the case some years ago in the auto industry, the U.S. could benefit from a fresh assessment of the role of "style" and "line" in the attraction a machine holds for a potential customer, and here the European example appears to have much to offer.

APPENDIX A

RAW DATA

TABLE A.1

U.S. MANUFACTURERS' HELICOPTER PRODUCTION[a]
CIVIL AND MILITARY

(000's CURRENT $)

YEAR	CIVIL	MILITARY	TOTAL
1960	...	173,000	...
1961	...	228,000	...
1962	...	250,000	...
1963	...	337,000	...
1964	...	356,000	...
1965	39,000	490,000	529,000
1966	40,000	749,000	789,000
1967	43,000	962,000	1,005,000
1968	57,000	905,000	962,000
1969	75,000	845,000	920,000
1970	49,000	694,000	743,000
1971	69,000	469,000	538,000
1972	90,000	396,000	486,000
1973	121,000	268,000	389,000
1974	189,000	206,000	395,000
1975	274,000	359,000	633,000
1976	305,000	410,000	715,000
1977	316,000	316,000	632,000

[a] Excludes the production by foreign licensees. Value does not include the value of aircraft produced for the security assistance programs and accepted by the USAF.

Source: Aerospace Industries Association, Aerospace Facts and Figures, (Washington D.C.: Aerospace Industries Association), various issues.

TABLE A.2

U.S. MANUFACTURERS'
HELICOPTER PRODUCTION
CIVIL AND MILITARY

(UNITS)

YEAR	CIVIL	MILITARY	TOTAL
1960	266	488	754
1961	378	366	744
1962	407	554	961
1963	504	672	1,176
1964	579	1,007	1,586
1965	598	1,470	2,068
1966	583	2,164	2,747
1967	455	2,448	2,903
1968	522	2,800	3,322
1969	534	2,165	2,699
1970	482	1,944	2,426
1971	469	1,587	2,056
1972	575	1,312	1,887
1973	770	808	1,578
1974	828	506	1,334
1975	864	601	1,465
1976	775	362	1,137
1977	884	273	1,157

Source: Aerospace Industries Association, Aerospace Facts and Figures, (Washington D.C.: Aerospace Industries Association), various issues.

TABLE A.3

PRODUCTION OF HELICOPTERS BY U.S. MANUFACTURERS FOR THE U.S. MILITARY BY SERVICE

(000's CURRENT $)

YEAR	AIR FORCE	ARMY	NAVY	TOTAL MILITARY
1960				
1961				
1962				
1963				
1964				
1965				
1966				
1967				
1968				
1969	41,000	548,000	256,000	845,000
1970	111,858	359,410	222,810	694,078
1971	122,000	281,000	66,000	469,000
1972	44,000	320,000	32,000	396,000
1973	41,000	143,000	84,000	268,000
1974	60,000	127,000	19,000	206,000
1975	79,000	259,000	21,000	359,000
1976	26,000	359,000	25,000	410,000
1977	0	312,000	4,000	316,000

Source: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.

TABLE A.4

FORECAST OF WORLD MILITARY
HELICOPTER PRODUCTION: U.S. AND NON-U.S. MANUFACTURERS, 1977-86

(UNITS)

YEAR	U.S.	NON-U.S.	NOT ALLOCATED	TOTAL
1977	371	472	0	843
1978	347	423	93	863
1979	404	327	154	885
1980	357	248	227	832
1981	286	138	319	743
1982	298	166	377	841
1983	255	142	398	795
1984	295	69	465	829
1985	280	30	341	651
1986	110	24	307	441

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Connecticut: DMS, INC.), 1977.

TABLE A.5

FORECASTS OF WORLD-WIDE
MILITARY HELICOPTER PRODUCTION, 1977-86

(UNITS)

YEAR	UNITS	VALUE (000 1977 $)
1977	843	873,000
1978	863	950,000
1979	885	1,396,000
1980	832	1,392,000
1981	743	1,159,000
1982	841	1,244,000
1983	795	1,230,000
1984	829	1,316,000
1985	651	1,105,000
1986	441	519,000

Source: Defense Marketing Service, World Aircraft Forecast to 1986 (Greenwich, Connecticut: DMS, INC.), 1977.

TABLE A.6

NON-U.S. PRODUCTION OF CIVIL HELICOPTERS

(UNITS)

YEAR	QUANTITY	
1960	...	
1961	...	
1962	...	
1963	...	
1964	...	
1965	297	
1966	386	
1967	427	
1968	430	
1969	433	
1970	465	
1971	484	
1972	432	
1973	526	
1974	452	
1975	455	Preliminary

Source: Survey by Wayne Hitchcock, Free World Civil Helicopter Study, 1976-1980, Sperry Flight System, Phoenix, Arizona.

TABLE A.7

PRODUCTION OF HELICOPTERS BY U.S. MANUFACTURERS FOR THE U.S. MILITARY BY SERVICE

(UNITS)

YEAR	AIR FORCE	ARMY	NAVY	TOTAL MILITARY
1960	57	284	147	494
1961	42	137	187	366
1962	33	313	208	624
1963	45	462	165	762
1964	34	828	145	1,099
1965	60	1,215	195	1,488
1966	80	1,831	253	2,242
1967	73	2,096	279	2,448
1968	37	2,565	198	2,800
1969	47	1,918	200	2,165
1970	122	1,615	207	1,944
1971	355	1,154	78	1,587
1972	177	1,106	29	1,312
1973	150	616	42	808
1974	188	286	25	499
1975	191	375	28	594
1976	14	324	24	362
1977	0	242	31	273

Source: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.

TABLE A.8

FOREIGN SHARE OF U.S.
CIVIL HELICOPTER MARKET

(000's CURRENT $)

Year (1)	U.S. civil production of helicopters not exports (2)	U.S. non-military imports of helicopters (3)	Total going to U.S. market (4)	Foreign share (3)/(4) (5)
1960	N.A.	N.A.	...	...
1961	N.A.	N.A.	...	...
1962	N.A.	N.A.	...	...
1963	N.A.	N.A.	...	...
1964	N.A.	1,194	...	...
1965	22,786	0	22,786	.00
1966	28,456	0	28,456	.00
1967	17,795	260	18,055	.01
1968	24,045	4,000	28,045	.14
1969	45,869	217	46,086	.00
1970	21,403	4,977	26,380	.19
1971	23,297	4,550	27,847	.16
1972	39,728	1,777	41,505	.04
1973	37,679	8,049	45,728	.18
1974	79,373	8,051	87,424	.09
1975	169,354	6,913	176,267	.04
1976	191,649	4,433	196,082	.02
1977	210,493	18,070	228,563	.08

N/A: Not Available

Sources: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.
U.S. Bureau of the Census, U.S. Imports, Report FT246 (Washington, D.C.: USGPO), various issues.
U.S. Bureau of the Census, U.S. Exports, Reports FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.9

FORECAST FOR WORLD
AIR CARRIER HELICOPTER PRODUCTION 1977-86

(UNITS)

YEAR / TYPE		Actual thru 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
BELL	204	1	1	1	1	1	1	1	1	1	1	1
	206	22	22	22	22	22	21	21	20	20	20	20
	212	5	5	5	5	5	5	5	5	5	5	5
	47	2	2	2	2	2	2	2	2	1	1	1
FUJI-BELL	204-B	2	2	2	2	2	2	2	1	1	1	1
HUGHES	500	7	7	7	7	7	7	7	7	7	7	7
KAWASAKI	KH-4	12	12	12	12	12	12	11	10	10	10	10
KAWASAKI-BELL	47-G	6	6	6	4	4	2	2	..	..	..	..
SIKORSKY	S-61	2	3	3	3	3	3	3	3	3	3	3
TOTAL		59	60	60	58	58	55	54	49	48	48	48

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Connecticut: D.M.S., INC.), 1977-78.

TABLE A.10

U.S. CIVIL PRODUCTION OF HELICOPTERS NOT EXPORTED

(UNITS)

Year (1)	U.S. civil production (2)	U.S. civil exports (3)	U.S. civil production of helicopters not-exported (2) - (3) (4)
1960	266	82	184
1961	378	119	259
1962	407	110	297
1963	504	123	381
1964	579	123	456
1965	598	177	421
1966	583	161	422
1967	455	223	232
1968	522	242	280
1969	534	252	282
1970	482	335	147
1971	469	298	171
1972	575	254	321
1973	770	428	342
1974	828	396	432
1975	864	336	528
1976	775	315	460
1977	884	321	563

Sources: Aerospace Industries Association of America, Aerospace Facts and Figures, (Washington, D.C.: Aerospace Industries Association), various issues. U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.11

U.S. CIVIL PRODUCTION OF HELICOPTERS NOT EXPORTED

(000's CURRENT $)

Year (1)	U.S. civil production (2)	U.S. civil exports (3)	U.S. civil production of helicopters not exported (2) - (3) (4)
1960	...	7,701	...
1961	...	6,846	...
1962	...	8,777	...
1963	...	9,811	...
1964	...	14,619	...
1965	39,000	16,214	22,786
1966	40,000	11,544	28,456
1967	43,000	25,205	17,795
1968	57,000	32,955	24,045
1969	75,000	29,131	45,869
1970	49,000	27,597	21,403
1971	69,000	45,703	23,297
1972	90,000	50,272	39,728
1973	121,000	83,321	37,679
1974	189,000	109,627	79,373
1975	274,000	104,646	169,354
1976	305,000	113,351	191,649
1977	316,000	105,507	210,493

Sources: Aerospace Industries Association of America, Aerospace Facts and Figures. (Washington, D.C.: Aerospace Industries Assocation), various issues.
U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.12

U.S. IMPORTS AND EXPORTS OF
CIVIL HELICOPTERS
(UNITS)

YEAR	EXPORTS	IMPORTS	EXPORTS MINUS IMPORTS
1960	82	NA	...
1961	119	NA	...
1962	110	NA	...
1963	123	NA	...
1964	123	10	113
1965	177	0	177
1966	161	0	161
1967	223	10	113
1968	242	1	241
1969	252	3	249
1970	335	39	296
1971	298	34	264
1972	254	12	242
1973	428	44	384
1974	396	41	355
1975	336	36	300
1976	315	42	273
1977	321	56	265

Sources: U.S Bureau of the Census, U.S. Imports, Report FT246, Washington, D.C., various issues.
U.S. Bureau of the Census, U.S. Exports, Report FT410, Washington, D.C., various issues.

TABLE A.13

CIVIL HELICOPTERS OPERATED
IN THE UNITED STATES AND CANADA
BY TYPE OF USER, 1960-1977

(UNITS)

YEAR	COMMERCIAL[a]	COMPANIES and EXECUTIVES	GOVERNMENT AGENCIES	TOTAL
1960	705	134	97	936
1961	882	173	124	1,179
1962	994	213	112	1,319
1963	1,157	218	122	1,497
1964	1,333	311	123	1,767
1965	1,537	401	115	2,053
1966	1,699	475	144	2,318
1967	1,764	487	187	2,438
1968	N.A.	N.A	N.A	N.A.
1969	2,390	770	273	3,433
1970	N.A.	N.A	N.A	N.A.
1971	2,605	802	467	3,874
1972	2,992	745	448	4,185
1973	3,295	780	526	4,601
1974	3,418	778	623	4,819
1975	3,342	1,056	824	5,222
1976	3,702	1,392	1,087	6,181
1977	4,294	1,578	1,288	7,160

[a]All helicopters for hire

Source: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.

TABLE A.14

FOREIGN SHARE OF U.S.
CIVIL HELICOPTER MARKET

(UNITS)

Year (1)	U.S. civil production of helicopters not exported (2)	U.S. non-military import of helicopters (3)	Total going to U.S. (4)	Foreign share (3)/(4) (5)
1960	184	N.A	...	...
1961	259	N.A	...	...
1962	297	N.A	...	...
1963	381	N.A	...	...
1964	456	10	466	.02
1965	421	0	421	.00
1966	422	0	422	.00
1967	232	10	242	.04
1968	280	1	281	.00
1969	282	3	285	.01
1970	147	39	186	.21
1971	171	34	205	.17
1972	321	12	333	.04
1973	342	44	386	.11
1974	432	41	473	.09
1975	528	36	564	.06
1976	460	42	502	.08
1977	563	56	619	.09

Sources: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.
U.S. Bureau of the Census, U.S. Imports, Report FT246 (Washington, D.C.: USGPO), various issues.
U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.15

HELICOPTER TRAFFIC, UNITED STATES
SCHEDULED AIRLINES, 1960-1976
(000's)

YEAR	MILES FLOWN	PASSENGERS CARRIED	PASSENGER MILES	TON-MILES
1960	2,219	430	9,475	1,054
1961	2,157	490	8,604	963
1962	1,518	359	8,192	897
1963	1,462	458	12,510	1,317
1964	1,976	608	16,003	1,668
1965	1,984	718	18,811	1,948
1966	2,241	1,067	25,420	2,562
1967	2,660	1,220	29,670	2,960
1968	2,547	1,042	24,856	2,482
1969	1,909	737	17,074	1,703
1970	1,427	573	11,341	1,167
1971	1,048	551	8,973	917
1972	1,022	587	10,009	1,020
1973	1,085	613	10,936	1,108
1974	1,029	592	10,298	1,055
1975	873	505	8,370	868
1976[a]	709	444	7,490	755

[a] Estimate.

Source: Civil Aeronautics Board, Bureau of Accounts and Statistics. Reproduced in Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.

TABLE A.16

FORECAST OF WORLD-WIDE MILITARY HELICOPTER PRODUCTION BY TYPE: U.S. - NON-U.S. MANUFACTURERS (1977-1986)

ATTACK HELICOPTER

YEAR	U.S.	FOREIGN	NOT ALLOCATED
1977	85	0	0
1978	130	8	0
1979	158	30	0
1980	139	38	0
1981	38	42	0
1982	58	88	48
1983	14	102	56
1984	48	54	108
1985	48	30	36
1986	56	24	36

MEDIUM

YEAR	U.S.	FOREIGN	NOT ALLOCATED
1977	252	247	0
1978	195	233	26
1979	230	192	58
1980	202	158	108
1981	228	75	162
1982	226	78	189
1983	241	40	214
1984	247	15	205
1985	232	0	183
1986	54	0	118

LIGHT HELICOPTER

YEAR	U.S.	FOREIGN	NOT ALLOCATED
1977	17	185	0
1978	19	156	61
1979	0	77	96
1980	0	52	118
1981	0	21	156
1982	0	0	140
1983	0	0	116
1984	0	0	140
1985	0	0	122
1986	0	0	153

HEAVY

YEAR	U.S.	FOREIGN	NOT ALLOCATED
1977	17	40	0
1978	3	26	6
1979	16	28	0
1980	16	0	1
1981	20	0	1
1982	14	0	0
1983	0	0	12
1984	0	0	12
1985	0	0	0
1986	0	0	0

Source: Defense Marketing, Services, World Aircraft Forecast to 1986 (Greenwich, Connecticut: DMS, INC.), 1977.

TABLE A.17

U.S. IMPORTS AND EXPORTS OF
CIVIL HELICOPTERS
(000's CURRENT $)

YEAR	EXPORTS	IMPORTS	EXPORTS MINUS IMPORTS
1960	7,701	N.A.	...
1961	6,846	N.A.	...
1962	8,777	N.A.	...
1963	9,811	N.A.	...
1964	14,619	1,194	13,425
1965	16,214	0	16,214
1966	11,544	0	11,544
1967	25,205	260	24,945
1968	32,955	4,000	28,955
1969	29,131	217	28,914
1970	27,597	4,797	22,800
1971	45,703	4,550	41,153
1972	50,272	1,777	48,495
1973	83,321	8,049	75,272
1974	109,627	8,051	101,576
1975	104,646	6,913	97,733
1976	113,351	4,433	108,918
1977	105,507	18,070	87,437

Sources: U.S. Bureau of the Census, U.S. Imports, Report FT246, Washington, D.C., various December issues.
U.S. Bureau of the Census, U.S. Exports, Report FT410, Washington, D.C., various December issues.

TABLE A.18

SHARE OF U.S. CIVIL HELICOPTER EXPORTS GOING TO SELECTED EUROPEAN COUNTRIES

(UNITS)

YEAR	U.S. export of civil helicopters going to France, Italy, U.K., West Germany	U.S. total export of civil helicopters	U.S. export of civil helicopters going to selected European countries
1960	8	82	.10
1961	4	119	.03
1962	32	110	.29
1963	20	123	.16
1964	9	123	.07
1965	15	177	.08
1966	14	161	.09
1967	19	223	.09
1968	22	242	.09
1969	32	252	.13
1970	30	335	.09
1971	9	298	.03
1972	37	254	.15
1973	101	428	.24
1974	67	396	.17
1975	36	336	.11
1976	34	315	.11
1977	35	321	.11

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.19

SHARE OF U.S. CIVIL HELICOPTER EXPORTS
GOING TO SELECTED EUROPEAN COUNTRIES

(CURRENT $)

YEAR	U.S. export of civil helicopters going to France, Italy, U.K., West Germany	U.S. total export of civil helicopters	U.S. export of civil helicopters going to selected European countries
1960	1,641	7,701	.21
1961	106	6,846	.02
1962	1,694	8,777	.19
1963	688	9,811	.07
1964	1,712	14,619	.12
1965	1,345	16,214	.08
1966	628	11,544	.05
1967	1,282	25,205	.05
1968	2,754	32,955	.08
1969	2,434	29,131	.08
1970	2,313	27,597	.08
1971	2,799	45,703	.06
1972	9,666	50,272	.19
1973	19,696	83,321	.24
1974	31,887	109,627	.29
1975	15,806	104,646	.15
1976	19,061	113,351	.17
1977	25,009	105,507	.24

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.20
FORECAST OF WORLD
MILITARY HELICOPTER PRODUCTION BY TYPE, 1977-86
(UNITS)

YEAR	ATTACK HELICOPTER	LIGHT HELICOPTER	MEDIUM HELICOPTER	HEAVY HELICOPTER
1977	85	202	499	57
1978	138	236	454	35
1979	188	173	480	44
1980	177	170	468	17
1981	80	177	465	21
1982	194	140	493	14
1983	172	116	495	12
1984	210	140	467	12
1985	114	122	415	..
1986	116	153	172	..

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Connecticut: DMS, INC.), 1977.

TABLE A.21

CIVIL IMPORTS OF HELICOPTERS
AS A PROPORTION OF U.S. CIVIL PRODUCTION

(UNITS)

YEAR	CIVIL IMPORTS	U.S. CIVIL PRODUCTION	RATIO: (2)/(3)
(1)	(2)	(3)	(4)
1960	N.A.	266	...
1961	N.A.	378	...
1962	N.A.	407	...
1963	N.A.	504	...
1964	10	579	.02
1965	0	598	.00
1966	0	583	.00
1967	10	455	.02
1968	1	522	.00
1969	3	534	.01
1970	39	482	.08
1971	34	469	.07
1972	12	575	.02
1973	44	770	.06
1974	41	828	.05
1975	36	864	.04
1976	42	775	.05
1977	56	884	.06

NA: Not Available

Source: Aerospace Industries Association of America, Aerospace Facts and Figures, (Washington, D.C.: Aerospace Industries Association) various issues.
U.S. Bureau of the Census, U.S. Imports, Report FT226 (Washington, D.C.: USGPO), various issues.

TABLE A.22

CIVIL IMPORTS OF HELICOPTERS
AS A PROPORTION OF U.S. CIVIL PRODUCTION
(000's CURRENT $)

YEAR	CIVIL IMPORTS	U.S. CIVIL PRODUCTION	RATIO: (2)/(3)
(1)	(2)	(3)	(4)
1960	N.A.	...	...
1961	N.A.	...	...
1962	N.A.	...	...
1963	N.A.	...	...
1964	1194	...	...
1965	0	39,000	.00
1966	0	40,000	.00
1967	260	43,000	.01
1968	4000	57,000	.07
1969	217	75,000	.00
1970	4797	49,000	.10
1971	4550	69,000	.07
1972	1777	90,000	.02
1973	8049	121,000	.07
1974	8051	189,000	.04
1975	6913	274,000	.03
1976	4433	305,000	.01
1977	18070	316,000	.06

Source: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.
U.S. Bureau of the Census, U.S. Imports, Report FT246 (Washington, D.C.: USGPO), various issues.

TABLE A.23

CIVIL HELICOPTERS OPERATED IN THE U.S. AND CANADA, 1960-1977

(UNITS)

YEAR	TOTAL UNITS[a]	CHANGE FROM PREVIOUS YEAR
1960	936	...
1961	1,179	243
1962	1,319	140
1963	1,497	178
1964	1,767	270
1965	2,053	286
1966	2,318	265
1967	2,438	120
1968	.....	...
1969	3,433	...
1970	.....	...
1971	3,874	...
1972	4,185	311
1973	4,601	416
1974	4,819	218
1975	5,222	403
1976	6,181	959
1977	7,160	979

[a] Includes helicopters on order.

Source: Aerospace Industries Association of America, Aerospace Facts and Figures, (Washington, D.C.: Aerospace Industries Association), various issues.

TABLE A.24

ACTUAL (1973-77) AND FORECAST (1978-89)
OF ACTIVE GENERAL AVIATION HELICOPTER FLEET

(UNITS)

YEAR	UNITS
1973	2,800
1974	3,100
1975	3,600
1976	4,100
1977	4,500
1978	4,800
1979	4,900
1980	5,000
1981	5,200
1982	5,400
1983	5,600
1984	5,900
1985	6,100
1986	6,300
1987	6,500
1988	6,700
1989	6,900

Source: General Aviation Manufacturers Association, 1977 Statistical Data (Washington, D.C.: General Aviation Manufacturers Association), 1977.

TABLE A.25

MILITARY HELICOPTER FLEET
EUROPEAN DESIGNED AND AMERICAN DESIGNED
BY MAJOR WORLD AREAS, 1975
(M.U.A)[a]

COUNTRY (1)	EUROPEAN DESIGNED (2)	AMERICAN DESIGNED (3)	TOTAL (4)	U.S SHARE (5)
1. U.S.A.	0.0	4728.6	4728.6	1.00
2. Canada	0.0	58.6	58.6	1.00
3. Latin America	30.2	92.9	123.1	0.75
4. Europe, outside the E.E.C.	197.1	84.1	281.2	0.30
5. Middle East and North Africa	325.7	150.3	476.0	0.32
6. Africa, south of the Sahara and the Malagasy Republic	46.1	4.4	50.5	0.09
7. South Africa and Rhodesia	76.8	0.0	78.8	0.00
8. Asia	41.1	67.3	108.4	0.62
9. Australia	23.0	52.5	75.5	0.70
10. Oceania	0.3	12.3	12.6	0.98
11. E.E.C.	967.0	220.5	1187.5	0.19
12. The world excluding the E.E.C.	740.3	5251.0	5991.3	0.88
13. World	1707.3	5471.5	7178.8	0.76

[a] M.U.A.: Million Units of Account. In 1975, one unit of account equaled $1.32.

Source: Based on the Commission of the European Communities, The European Aerospace Industry Trading Position and Figures, mimeographed, Brussels, Belgium, August 2, 1977.

TABLE A.26

E.E.C. MILITARY HELICOPTER FLEET BY EUROPEAN DESIGNED AND AMERICAN DESIGNED, 1975

(M.U.A)a

COUNTRY (1)	EUROPEAN DESIGNED (2)	AMERICAN DESIGNED (3)	TOTAL (4)	U.S SHARE (5)
BELGIUM	6.9	2.1	9.0	.23
DENMARK	1.2	6.1	7.3	.84
FRANCE	279.7	2.5	282.2	.01
IRELAND	1.2	0	1.2	0
ITALY	241.7	39.4	281.1	.14
NETHERLANDS	16.6	0	16.6	0
U.K.	309.7	0.8	310.5	0
W. GERMANY	110.0	169.6	279.6	.61
E.E.C. Total	967.0	220.5	1187.5	.19

[a] M.U.A.: Million Units of Account. In 1975, one unit of account equaled $1.32.

Source: Based on the Commission of the European Communities, The European Aerospace Industry Trading Position and Figures, mimeographed, Brussels, Belgium, August 2, 1977.

TABLE A.27

EUROPEAN CIVIL HELICOPTER FLEET
BY COUNTRY, 1975

(UNITS)

FRANCE	181
ITALY	128
W. GERMANY	170
U.K.	375
Other member countries	72
TOTAL E.E.C.	926
Other European, non-member countries	256
EUROPEAN TOTAL	1,180
U.S.A. and CANADA	5,670
Rest of the "Western" World (excluding U.S.A., CANADA and EUROPE)	2,150

Source: Based on the Commission of the European Communities, The European Aerospace Industry Trading Position and Figures, mimeographed, Brussels, Belgium, August 2, 1977.

TABLE A.28

EUROPEAN CIVIL HELICOPTER FLEET
BY COUNTRY, 1968, 1970, 1972, 1975.
(UNITS)

Country	1968	1970	1972	1975	% Change 1968-1975
FRANCE	87	86	89	181	108
ITALY	65	76	81	128	97
W. GERMANY	79	111	155	170	115
UNITED KINGDOM	141	160	186	375	166
TOTAL	372	433	511	854	130

Source: - 1968, 1970, 1972: Heidewig Bornemann, "Civil Helicopter Fleets in some western European countries 1968-1972", ITA Study 1973/3-E.
- 1975: Based on the Commission of the European Communities, The European Aerospace Industry Trading Position and Figures, mimeographed, Brussels, Belgium, August 2, 1977.

TABLE A.29

U.S. EXPORT OF CIVIL HELICOPTERS

(UNITS)

YEAR	UNDER 2000 POUNDS EMPTY AIRFRAME WEIGHT[a]	2000 POUNDS AND OVER EMPTY AIRFRAME WEIGHT[a]	TOTAL
1960[a]	70	12	82
1961[a]	112	7	119
1962[a]	97	13	110
1963[a]	109	14	123
1964[a]	101	22	123
1965	110	67	177
1966	119	42	161
1967	165	57	223
1968	169	73	242
1969	212	40	252
1970	284	51	335
1971	230	68	298
1972	184	70	254
1973	317	111	428
1974	267	128	396
1975	210	126	336
1976	201	114	315
1977	233	88	321

[a] Prior to 1965 Rotary-wing aircraft were classified as: (1) 3000 pounds and over; (2) under 3000 pounds.

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.30

U.S. EXPORT OF CIVIL HELICOPTERS
(000's CURRENT $)

YEAR	UNDER 2000 POUNDS EMPTY AIRFRAME WEIGHT[a]	2000 POUNDS AND OVER EMPTY AIRFRAME WEIGHT[a]	TOTAL
1960[a]	3,736	3,965	7,701
1961[a]	5,456	1,390	6,846
1962[a]	4,161	4,616	8,777
1963[a]	3,935	5,876	9,811
1964[a]	4,381	10,238	14,619
1965	4,742	11,472	16,214
1966	5,097	6,447	11,544
1967	9,943	15,262	25,205
1968	11,929	21,026	32,955
1969	12,696	16,435	29,131
1970	17,139	10,458	27,597
1971	17,926	27,777	45,703
1972	17,089	33,183	50,272
1973	33,069	50,252	83,321
1974	29,723	79,904	109,627
1975	27,463	77,182	104,646
1976	28,135	85,216	113,351
1977	37,966	67,541	105,507

[a] Prior to 1965, Rotary-wing aircraft were classified as: (1) 3000 pounds and over; (2) under 3000 pounds.

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410, Washington, D.C., various December issues.

TABLE A.31

U.S. EXPORT OF CIVIL HELICOPTERS
TO SELECTED COUNTRIES

(UNITS)

YEAR	FRANCE	ITALY	U.K.	W. GERMANY
1960	0	0	4	4
1961	0	1	1	2
1962	1	1	28	2
1963	0	2	15	3
1964	0	0	7	2
1965	1	0	9	5
1966	0	0	8	6
1967	0	3	6	10
1968	0	2	6	14
1969	0	3	10	9
1970	0	3	11	16
1971	0	1	3	5
1972	0	3	26	8
1973	1	20	65	15
1974	6	22	28	11
1975	6	15	13	2
1976	9	3	8	14
1977	4	4	16	11

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.32

U.S. EXPORT OF CIVIL HELICOPTERS
TO SELECTED COUNTRIES

(000's CURRENT $)

YEAR	FRANCE	ITALY	U.K.	W. GERMANY
1960	0	0	1039	602
1961	0	70	2	34
1962	18	17	1585	74
1963	0	41	585	62
1964	0	0	1667	45
1965	45	0	1125	175
1966	0	0	396	232
1967	0	138	369	775
1968	0	1011	638	1105
1969	0	1264	849	321
1970	0	218	901	1194
1971	0	22	2484	293
1972	0	721	8376	569
1973	43	2102	13451	4100
1974	886	6059	21664	3278
1975	396	380	14649	381
1976	903	6478	8285	3395
1977	412	356	19704	4537

Source: U.S. Bureau of The Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.33

U.S. MILITARY EXPORT OF HELICOPTERS, 1960-77
(UNITS AND CURRENT DOLLARS)

	Units	Value
1960	NA	NA
1961	NA	NA
1962	NA	NA
1963	NA	NA
1964	NA	NA
1965	57	23,292,769
1966	63	17,445,365
1967	108	18,141,330
1968	65	9,784,886
1969	108	32,540,858
1970	64	22,224,288
1971	126	43,844,689
1972	149	53,124,829
1973	79	37,608,244
1974	73	50,118,913
1975	116	123,305,143
1976	139	101,824,388
1977	95	83,685,219

Source: U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

NA: Not Available

TABLE A.34

FORECAST OF WORLDWIDE MILITARY AND CIVIL HELICOPTER PRODUCTION, 1977-1983 (UNITS)

Year	Civil	Military	Total
1977	989	945	1934
1978	1158	911	2069
1979	1293	919	2212
1980	1319	901	2220
1981	1280	852	2132
1982	1246	779	2025
1983	1200	830	2030

Source: Forecast Associates Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates Inc.), 1977.

TABLE A.35

TOTAL WORLDWIDE AND U.S. CIVIL HELICOPTERS ON REGISTER, 1960-76
(UNITS)

Year	U.S.	Worldwide	U.S. Share
(1)	(2)	(3)	(2)/(3)
1960			
1961			
1962			
1963			
1964	1325	2167	.61
1965			
1966			
1967	1925	3459	.56
1968	2373	4073	.58
1969	2583	4545	.57
1970	2270	4612	.49
1971			
1972	4259	7217	.59
1973	4720	8053	.59
1974	5391	9274	.58
1975	6007	10147	.59
1976	6387	11061	.58

Source: International Civil Aviation Organization, Civil Aircraft on Register (Montreal, Canada: International Civil Aviation Organization), various annual issues.

TABLE A.36

TOTAL U.S. CIVIL HELICOPTERS ON REGISTER
(UNITS)

YEAR	Commercial Air Transport Operators[a]	Other Operators	Total
1960			
1961			
1962			
1963			
1964	19	1306	1325
1965			
1966			
1967	26	1899	1925
1968	23	2350	2373
1969	27	2556	2583
1970	24	2246	2270
1971			
1972	773	3486	4259
1973	881	3839	4720
1974	954	4437	5391
1975	1125	4882	6007
1976	1254	5133	6387

Source: International Civil Aviation Organization, Civil Aircraft on Register (Montreal, Canada: International Civil Aviation Organization), various annual issues.

[a]Includes data on air taxi operators. Number of helicopters of air taxi operators is partially estimated by U.S.

TABLE A.37

TOTAL U.S. CIVIL HELICOPTERS ON REGISTER
(UNITS)

Year	Commercial Air Transport Operators[a]		Other Operators		Total	
	20,000 lbs. and over	Under 20,000 lbs.	20,000 lbs. and over	Under 20,000 lbs.	20,000 lbs. and over	Under 20,000 lbs.
1960						
1961						
1962						
1963						
1964	0	19	0	1306	0	1325
1965						
1966						
1967	0	26	2	1897	2	1923
1968	0	23	4	2346	4	2369
1969	0	27	5	2551	5	2578
1970	0	24	4	2242	4	2266
1971						
1972	0	773	12	3474	12	4247
1973	0	881	15	3824	15	4705
1974	0	954	16	4421	16	5375
1975	0	1125	16	4866	16	5991
1976	0	1254	20	5113	20	6367

Source: International Civil Aviation Organization, Civil Aircraft on Register (Montreal, Canada: International Civil Aviation Organization), various annual issues.

[a]Includes data on air taxi operators. Number of helicopters of air taxi operators is partially estimated by U.S.

TABLE A.38

TOTAL WORLDWIDE CIVIL HELICOPTERS ON REGISTER
(UNITS)

	Commercial Air Transport Operators[a]		Other Operators		Total	
		20,000 lbs.		20,000 lbs.		20,000 lbs.
1960						
1961						
1962						
1963						
1964	0	550	0	1617	0	2167
1965						
1966						
1967	0	878	2	2579	2	3457
1968	0	967	4	3102	4	4069
1969	0	1147	5	3393	5	4540
1970	0	1192	5	3415	5	4607
1971						
1972	5	2215	12	4985	17	7200
1973	3	2471	19	5560	22	8031
1974	23	2690	23	6538	46	9228
1975	29	2920	20	7178	49	10098
1976	35	3291	24	7711	59	11002

Source: International Civil Aviation Organization, Civil Aircraft on Register (Montreal, Canada: International Civil Aviation Organization), various annual issues.

[a]Includes data on air taxi operators. Number of helicopters of air taxi operators is partially estimated by U.S.

TABLE A.39

TOTAL WORLDWIDE CIVIL HELICOPTERS ON REGISTER
(UNITS)

YEAR	Commercial Air Transport Operators[a]	Other Operators	Total
1960			
1961			
1962			
1963			
1964	550	1617	2167
1965			
1966			
1967	878	2581	3459
1968	967	3106	4073
1969	1147	3398	4545
1970	1192	3420	4612
1971			
1972	2220	4997	7217
1973	2474	5579	8053
1974	2713	6551	9274
1975	2949	7198	10147
1976	3326	7735	11061

Source: International Civil Aviation Organization, Civil Aircraft on Register (Montreal, Canada: International Civil Aviation Organization), various annual issues.

[a]Includes data on air taxi operators. Number of helicopters of air taxi operators is partially estimated by U.S.

TABLE A.40

TOTAL U.S. HELICOPTER FLEET OF THE AIR CARRIERS, TOTAL AIRBORNE HOURS, AND TOTAL STATUTE MILES, 1977-89 (UNITS)

Year	Units	Total Airborne Hours	Total Statute Miles
Actual			
1977	4	10,000	1,000,000[E]
Forecast			
1978	4	10,000	1,000,000
1979	5	10,000	1,000,000
1980	5	10,000	1,000,000
1981	5	10,000	1,000,000
1982	5	10,000	1,000,000
1983	6	10,000	1,000,000
1984	6	10,000	1,000,000
1985	6	10,000	1,000,000
1986	7	10,000	1,000,000
1987	7	10,000	1,000,000
1988	7	10,000	1,000,000
1989	8	10,000	1,000,000

[E] Estimate

Source: Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1978-1989 (Washington, D.C.: USGPO), September, 1977.

TABLE A.41

ACTIVE U.S. MILITARY HELICOPTER FLEET
AND TOTAL FLYING HOURS
(UNITS)

Year	Units	Change From Previous Year	Military Helicopter Flying Hours (000's)	Change From Previous Year
Actual				
1973	8171		1,964	
1974	7991	-180	1,532	-432
1975	7138	-853	1,453	- 79
1976	7649	-511	1,571	118
1977[E]	7694	45	1,539	- 32
Forecast				
1978	7895	201	1,580	41
1979	7666	-229	1,616	36
1980	7706	40	1,646	30
1981	7782	76	1,631	- 15
1982	7824	42	1,615	- 16
1983	7576	-248	1,615	0
1984	7601	25	1,615	0
1985	7613	12	1,615	0
1986	7613	0	1,615	0
1987	7613	0	1,615	0
1988	7613	0	1,615	0
1989	7613	0	1,615	0

[E] Estimate

Source: Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1978-1989 (Washington, D.C.: USGPO), September, 1977.

TABLE A.42

ESTIMATED ACTIVE GENERAL AVIATION HELICOPTER FLEET
(UNITS)

Year	Units	Estimated Hours Flown (In Millions)
Actual		
1973	2800	1.1
1974	3100	1.3
1975	3600	1.5
1976	4100	1.7
1977	4500	0.4
Forecast		
1978	4800	1.8
1979	4900	1.9
1980	5000	2.0
1981	5200	2.1
1982	5400	2.1
1983	5600	2.2
1984	5900	2.3
1985	6100	2.4
1986	6300	2.4
1987	6500	2.5
1988	6700	2.6
1989	6900	2.7

Source: Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1978-1989 (Washington, D.C.: USGPO), September, 1977.

TABLE A.43

ACTIVE U.S. MILITARY[a] HELICOPTERS IN CONTINENTAL UNITED STATES BY SERVICE AS OF JUNE 30, 1972-88
(UNITS)

Year	Total	USAF	Army	Navy
Actual				
1972	6,649	500	5,251	898
1973	8,171	405	6,872	894
1974	7,991	309	6,821	861
1975	7,138	313	5,904	921
1976	7,744	244	6,482	1,018
Forecast				
1977	7,720	240	6,450	1.030
1978	7,773	242	6,500	1,031
1979	7,748	241	6,475	1,032
1980	7,720	238	6,425	1,057
1981	7,752	237	6,436	1,079
1982	7,826	236	6,508	1,082
1983[b]	7,832	237	6,508	1,087
1984	7,864	237	6,508	1,119
1985	7,864	237	6,508	1,119
1986	7,864	237	6,508	1,119
1987	7,864	237	6,508	1,119
1988	7,864	237	6,508	1,119

[a]Includes Army, Air Force, Navy and Marine service aircraft, as well as Reserve and National Guard aircraft.

[b]Detailed planning information not available beyond 1983. 1984-1988 projected at the 1983 level.

Source: FAA, Office of Aviation Policy, Aviation Forecast Branch, Military Aviation Forecasts Fiscal Years 1977-1988, Report No. FAA-AVP-76-15, Washington, D.C., August, 1976.

TABLE A.44

ACTIVE U.S. HELICOPTER PILOTS, 1973-89
(UNITS)

Year	Number	Change From Previous Year
Actual		
1973	7,987	
1974	5,968	-2019
1975	5,647	- 321
1976	4,932	- 715
1977	4,804	- 128
Forecast		
1978	4,700	- 104
1979	4,700	0
1980	4,600	- 100
1981	4,600	0
1982	4,600	0
1983	4,500	-100
1984	4,500	0
1985	4,500	0
1986	4,600	100
1987	4,600	0
1988	4,600	0
1989	4,700	100

Source: Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1978-1989 (Washington, D.C.: USGPO), September, 1977.

TABLE A.45

FREE-WORLD COMMERCIAL HELICOPTERS
ANNUAL SALES (MILLIONS OF 1978 DOLLARS)

Year	Millions of Dollars
1977	$480
1978	520
1979	570
1980	600
1981	625
1982	665
1983	675
1984	700

	Without NASA Research	With NASA Research
1985	750	800
1986	775	850
1987	800	950
1988	840	1075
1989	900	1175
1990	950	1275

Source: Boeing Vertol Company.

TABLE A.46

WORLD CIVIL HELICOPTER PRODUCTION, 1960-90

Year	U.S. Production of Civil Helicopters[1,a]	Foreign Production of Civil Helicopters[b]	World Production of Civil Helicopters[a,b]
Actual			
1960	266	NA	NA
1961	378	NA	NA
1962	407	NA	NA
1963	504	NA	NA
1964	579	NA	NA
1965	598	297	895
1966	583	386	969
1967	455	427	882
1968	522	430	952
1969	534	433	967
1970	482	465	947
1971	469	484	953
1972	575	432	1007
1973	770	526	1296
1974	828	452	1280
1975	864	455 Preliminary	1319
1976	775	NA	NA
1977	884	NA	NA

Forecast Year	DMS[c]	Forecast Associates[1,d]	GE[e]	FAA[f]
1978	1394	989	660	836
1979	1632	1158	830	841
1980	1767	1293	1000	850
1981	1855	1319	1170	864
1982		1246	1340	870
1983		1200	1510	NA
1984			1680	
1985			1850	
1986			2020	
1987			2190	
1988			2360	
1989			2530	
1990			2700	

[1]Excludes the production by foreign licensees.

[2]Forecast Associates civil forecast is for turbine helicopters only. (Recently piston helicopters have accounted for about 20 percent of world production). DMS civil forecast excludes helicopters produced by Agusta and MBB.

Sources: [a] Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various issues.

[b] Survey by Wayne Hitchcock, Free World Civil Helicopter Study, 1976-1980 (Phoenix, Arizona: Sperry Flight Systems), April, 1976.

[c] Defense Marketing Services, Monthly Intelligence Reports: Civil Aircraft (Greenwich, Ct.: DMS, Inc.), 1977.

[d] Forecast Associates, Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates, Inc.), 1977.

[e] Aircraft Engine Group of the General Electric Company Forecast, ORI interview.

[f] Federal Aviation Administration, FAA Aviation Forecast, Fiscal Years 1976-1987 (Washington, D.C.: USGPO), September 1975.

TABLE A.47
ACTIVE U.S. MILITARY[a] HELICOPTER FLYING
HOURS IN CONTINENTAL UNITED STATES, BY SERVICE
FISCAL YEARS 1972-1988
(000's)

Fiscal Year	Total	USAF	Army	Navy
Actual				
1972	1,780	200	322	1,252
1973	1,964	130	210	1,603
1974	1,532	91	171	1,149
1975	1,453	102	153	1,104
1976	1,578	74	89	1,210
Forecast				
1977	1,505	76	166	1,135
1978	1,497	78	171	1,140
1979	1,503	77	183	1,150
1980	1,531	77	194	1,170
1981	1,556	77	190	1,195
1982	1,570	77	188	1,200
1983[b]	1,580	77	188	1,210
1984	1,580	77	188	1,210
1985	1,580	77	188	1,210
1986	1,580	77	188	1,210
1987	1,580	77	188	1,210
1988	1,580	77	188	1,210

[a]Includes Army, Air Force, Navy and Marine service helicopters, as well as Reserve and National Guard.

[b]Detailed planning information not available beyond 1983. 1984-1988 projected at the 1983 level.

Source: FAA, Office of Aviation Policy, Aviation Forecast Branch, Military Aviation Forecasts Fiscal Years 1977-1988, Report No. FAA-AVP-76-15, Washington, D.C., August, 1976.

TABLE A-48
WORLD (CIVIL AND MILITARY) PRODUCTION FORECAST FOR TURBINE POWERED HELICOPTERS, BY MANUFACTURER AND MODEL, 1977-78
(UNITS)

MANUFACTURER/MODEL	Total Thru 1976	1977	1978	1979	1980	1981	1982	1983	Total 1977-1982	Total Estimated Production Thru 1983
AEROSPATIALE										
SA.3158	206	54	60	60	54	48	42	30	328	534
SA.3168	1561	60	56	48	42	40	-	-	246	1807
SA.318C	1315	-	-	-	-	-	-	-	-	1315
SA.3198	60	22	20	24	30	24	18	12	150	210
SA.321	90	10	10	6	6	8	8	6	54	144
SA.330	379	106	95	82	74	68	74	80	579	958
SA.341	408	104	92	86	78	78	56	48	542	950
SA.342	32	20	24	24	18	18	14	18	136	168
AS.350B	2	14	32	36	48	60	72	90	352	354
AS.350C	3	18	36	44	36	45	48	60	287	290
SA.360	14	48	64	80	94	82	96	96	560	574
SA.365	4	8	24	36	48	60	54	62	292	296
TOTAL	4074								3526	7600
AGUSTA										
A.109	36	54	72	72	64	70	72	60	464	500
A.129	-	1	3	6	14	24	24	24	96	96
	36								560	596
BELL										
AH-1G (and modifications)	1276	36	72	108	98	24	24	24	386	1662
AH-1J	69	54	-	-	-	-	-	-	54	123
AH-1S	3	42	70	72	72	46	-	-	302	305
AH-1T	1	2	24	31	-	-	-	-	57	57
TH/HH-1H	30	-	-	8	8	-	-	-	16	46
UH-1N	169	24	24	24	18	18	17	-	125	294
206A	294	72	56	60	60	30	18	12	318	612
206B/C	2126	302	248	244	208	187	192	180	1561	3687
206L	73	94	144	160	160	154	162	148	1022	1095
212	364	116	116	104	88	72	52	46	594	958
214A/C	150	123	79	78	92	114	128	156	770	920
214B	32	32	30	36	36	28	32	24	218	250
222	4	1	12	48	88	124	124	136	533	537
OTHER Previous Production	12842	-	-	-	-	-	-	-	-	12842
TOTAL	18087								5956	24043
BOEING VERTOL										
CH-46	773	6	6	6	4	-	-	-	22	795
CH-47	806	48	42	36	32	32	18	12	220	1026
TOTAL	1579								242	1821
HUGHES										
AH-64A	2	-	1	2	-	2	12	32	49	51
OH-6A	1434	-	-	-	-	-	-	-	-	1434
500/500M	444	52	43	22	6	6	-	-	129	573
500C	334	104	102	84	66	44	36	36	472	806
500D	48	76	124	162	180	166	140	122	970	1018
TOTAL	2262								1620	3882
MESSERSCHMITT BOLKOW BLOHM										
BO.105	313	88	108	114	132	144	136	130	852	1165
SIKORSKY										
HH-3 Series	886	32	36	38	30	30	24	8	198	1084
S-61	112	24	24	24	24	18	12	12	138	250
H-53/S-65	537	10	18	22	24	16	4	4	98	635
CH-53E	4	-	-	2	6	18	18	18	62	66
S-76	1	3	30	62	72	72	84	80	403	404
UH-60A	4	2	12	36	72	84	116	144	466	470
TOTAL	1544								1365	2909
WESTLAND										
Commando	30	12	12	14	18	18	24	24	122	152
Gazelle	172	48	34	30	25	12	12	12	173	345
Lynx	20	48	86	95	84	60	44	36	453	473
TOTAL	222								748	970
U.S.C.G.										
SRR	-	-	-	2	6	12	36	48	104	104
U.S.N.										
LAMPS MK III	-	-	-	2	3	-	6	24	35	35
TOTAL	28,117	1,934	2,069	2,212	2,220	2,132	2,025	2,030	15,908	43,235

NOTE: Data includes production by foreign licensees.

Source: Forecast Associates, Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates, Inc.), 1977.

TABLE A.49
TURBINE POWERED HELICOPTER MARKET THRU 1983
PRODUCTION & VALUE (millions of 1977 dollars)

MANUFACTURER/MODEL	APPROX PRICE	1977 UNITS	1977 VALUE	1977-1983 UNITS	1977-1983 VALUE
AEROSPATIALE SA.315B	0.3	54	16.2	328	98.4
SA.316B	0.4	60	24.0	246	98.4
SA.319B	0.3	22	6.6	150	45.0
SA.321	5.0	10	50.0	54	270.0
SA.330	1.9	106	201.4	579	1100.1
SA.341	0.3	104	31.2	542	162.6
SA.342	0.4	20	8.0	136	54.4
AS.350B	0.2	14	2.8	352	70.4
AS.350C	0.2	18	3.6	287	57.4
SA.360	0.6	48	28.8	560	336.0
SA.365	0.9	8	7.2	292	262.8
TOTAL					2555.5
AGUSTA A.109	0.7	54	37.8	464	324.8
A.129	1.5	1	1.5	96	144.0
TOTAL					468.8
BELL AH-1J	1.7	54	91.8	54	91.8
AH-1S	1.6	42	67.2	302	483.2
AH-1T	2.4	2	4.8	57	136.8
TH/HH-1H	0.5	-	-	16	8.0
UH-1N	1.3	24	31.2	125	162.5
205A	0.7	72	50.4	318	222.6
206B/C	0.2	302	60.4	1561	312.2
206L	0.3	94	28.2	1022	306.6
212	1.0	116	116.0	594	594.0
214A/C	1.3	123	159.9	770	1001.0
214B	1.5	32	48.0	218	327.0
222	0.9	1	0.9	533	479.7
TOTAL					4125.4
BOEING VERTOL CH-46 (KV-107II)	3.2	6	19.2	22	70.4
CH-47	3.5	48	168.0	220	770.0
TOTAL					840.4
HUGHES AH-64A	4.2	-	-	49	205.8
500/500M	0.2	52	10.4	129	25.8
500C	0.2	104	20.8	472	94.4
500D	0.2	76	15.2	970	194.0
TOTAL					520.0
MBB BO.105	0.4	88	35.2	852	340.8
SIKORSKY HH-3 Series	3.5	32	112.0	198	693.0
S-61	3.5	24	84.0	138	483.0
S-65/H-53	5.0	10	50.0	98	490.0
CH-53E	11.0	-	-	62	682.0
S-76	1.2	3	3.6	403	483.6
UH-60A	2.5	2	5.0	466	1165.0
TOTAL					3996.6
WESTLAND Commando	4.5	12	54.0	122	549.0
Gazelle	0.3	48	14.4	173	51.9
Lynx	1.8	48	86.4	453	815.4
TOTAL					1416.3
To be selected LAMPS	5.0	-	-	35	175.0
To be selected SRR	1.5	-	-	104	156.0
TOTALS		1,934	$1,756.1	14,622	$14,594.6

NOTE: Possible modifications to Boeing Vertol CH-46 and Kaman H-2 Seasprite not included.

Source: Forecast Associates, Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates, Inc.), 1977.

TABLE A.50

HELICOPTERS INCLUDED IN FORECAST ASSOCIATES WORLD FORECAST

The Medium/Heavy Helicopter Market

Aerospatiale
- SA. 321 Super Frelon
- SA. 330 Puma/Super Puma

Bell
- Bell 214 King Cobra

Boeing Vertol
- CH-47 Chinook (Model 234)

Kawasaki/Boeing Vertol
- KV-107 (CH-46)

Sikorsky
- H-3 Sea King (S-61)/Westland Sea King
- H-53/S-65 (Sea Stallion)

Westland
- Commando

The Market for Light/Intermediate Helicopters

Aerospatiale
- AS. 350B Ecureuil/AS. 350C Astar
- SA. 315B Lama/SA. 316B and SA. 319B Alouette
- SA. 341/SA.342 Gazelle
- SA. 360 Dauphin/SA. 365 Dauphin Two

Agusta
- A. 109/A. 129

Bell
- AH-1J/S/T
- UH-1/205/212
- Bell 206B/C JetRanger and 206L Long Ranger
- Bell 222

Hughes
- AH-64A Advanced Attack Helicopter (AAH)
- 500

MBB
- BO. 105

Sikorsky
S-76
UH-60A UTTAS

U.S.C.G. Short Range Recovery (SRR) Helicopter

U.S.N. LAMPS Mk. III Helicopter

Westland
WG. 13 Lynx

Source: Forecast Associates, Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates, Inc.), 1977.

TABLE A.51

HELICOPTERS INCLUDED IN DMS CIVIL FORECAST

AEROSPATIALE
- SA. 315B Lama
- SA. 316B Alouette 3
- SA. 318C Alouette 2
- SA. 319B Alouette 3 Astazou
- AS. 350 Astar (350C), Ecureuil (350B)
- SA. 360C Dauphin
- SA. 365 Dauphin 2
- SA. 341 Gazelle
- SA. 342 Gazelle
- SA. 330J Puma

BELL
- Bell 205A-1
- AB 205
- Bell 212
- AB 212
- Bell 206A/B/C/ JetRanger
- Bell 206L LongRanger
- Bell 206L-1 LongRanger II
- Agusta Bell AB206
- Bell 222

ENSTROM
- F-28
- Model 280
- F-28C
- Model 280C

HUGHES
- Model 269/269A/YOH-2
- Model 300 (269B/300C)
- Model 500

SIKORSKY
- S-76

Source: Defense Marketing Services, Monthly Intelligence Reports: Civil Aircraft (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.52
U.S. COAST GUARD AIRCRAFT INVENTORY
JUNE 30, 1976

Model	In Inventory			Out of Inventory			Grand Total
	Operational	Support (a)	Total	Reserve	Pend-Disp (b)	Total	
EC-130E	0	1	1	--	--	--	1
HC-130B	10	2	12	--	--	--	12
HC-130H	7	1	8	--	--	--	8
HH-3F	32	6	38	--	--	--	38
HH-52A	64	10	74	6	1	7	81
HU-16E	20	3	23	--	5	5	28
VC-4A	1	--	1	--	--	--	1
VC-11A	1	--	1	--	--	--	1
HC-131A	1	5	6	--	--	--	6
Total	136	28	164	6	6	12	176

Source: U.S. Department of Transportation, U.S. Coast Guard.

(a) Includes spares.
(b) Pending disposal.

TABLE A.53

DMS FORECAST OF WORLD CIVIL HELICOPTER PRODUCTION BY MANUFACTURER AND MODEL, 1978-82 (UNITS)

Manufacturer and Model	Produced thru 1977[c]	1978	1979	1980	1981	1982
AEROSPATIALE						
SA.315B Lama	184	20	14	12	10	
SA.316B/319B Alouette 3	1346	60	30	-	-	
AS.350 [350C Astar; 350B Ecureuil]	18	50	120	132	144	
SA.360C Dauphin	50	55	60	65	70	
SA.365 Dauphin 2	0	48	60	70	80	
SA.341/342 Gazelle	674	170	165	160	150	
SA.330J Puma	484	110	120	115	110	
Total	2756	513	569	554	564	
BELL						
BELL 205A-1	256	20	18	12	10	
AB 205A-1	90	3	3	2	1	
BELL 212	377	40	48	54	60	
AB 212	46	6	8	10	10	
JET RANGER (206A, 206B, 206C)	2340	260	275	295	300	300
LONGRANGER (206L, 206L-1)	170	85	95	105	110	120
BELL 222	5	-	65	130	150	180
Total	3257	414	512	608	641	600
ENSTROM						
F-28A	235	2	8	8	10	12
MODEL 280	100	2	8	12	14	18
F28C	116	72	70	74	80	90
MODEL 280C	106	72	76	86	100	110
Total	557	148	162	180	204	230
HUGHES						
MODEL 300 [269B/300C]	1810	115	125	135	140	150
MODEL 269/269A/YOH-Z	351	-	-	-	-	-
MODEL 500	1150	160	180	200	210	220
Total	3311	275	305	335	350	370
SIKORSKY						
S-76[b]	0	44	84	90	96	100
Worldwide Total	9881	1394	1632	1767	1855	N.A.

[a]Prototypes

[b]Does not include prototypes

[c]Production thru 1977 of Aerospatiale and Bell is estimated

Source: Defense Marketing Services, Monthly Intelligence Reports: Civil Aircraft (Greenwich, Ct.: DMS, Inc.), 1977.

U.S. MILITARY HELICOPTER PERTINENT DATA

DESIGNATION	MODEL DESIGNATION CURRENT	MODEL DESIGNATION FORMER	SERVICE	FIRST CONTRACT	FIRST FLIGHT	FIRST DELIVERY	END PRODUCTION	FLYAWAY COST (MILLIONS)
UH-1, Bell	UH-1	HU-1	Army	Feb 1955	Oct 1956	Aug 1958		339
Iroquois	UH-1A	HU-1A	Army	Feb 1958	Jun 1959	Jun 1959	Jun 1961	.270
	UH-1B	HU-1B	Army		1960	Mar 1961	Aug 1965	279
	UH-1C	None	Army		Sep 1965		1967	
		YHU-1D	Army	Jul 1960	Aug 1961			
	UH-1D	HU-1D	Army		Jun 1963	Aug 1963	1967	.337
	UH-1E	HU-1E	Navy	Mar 1962	Feb 1963	Feb 1964	1969	.314
	UH-1F	None	AF	Jun 1963	Feb 1964	Mar 1964	1967	.351
		YAH-1G	Army		Sep 1965	Dec 1965		
	AH-1G	None	Army	Mar 1966		1967		.461
	UH-1H	None	Army			Jan 1968		.715
	TH-1F	None	Navy				1967	
	AH-1J	None	Marines					
	HH-1K	None	Navy				1970	
	TH-1L	None	Navy				1971	
	UH-1N	None	Navy				1971	1.73
	UH-1L	None	Navy				1970	
	VH-1	None	Army					
	AH-1Q	None	Army	Jan 1974	Dec 1974	Jun 1975		3.0
	AH-1R	AH-1Q	Army					
	AH-1S		Army					1.5
	AH-1T	None	Marines		1976			3.9
UH-2, Kaman	UH-2A	HU2K-1	Navy	Nov 1957	Jul 1959	Dec 1962	1966	.340
Seasprite	UH-2B	HU2K-1U	Navy	1962		Aug 1963	1966	.340
	HH-2C	None	Navy					
	UH-2C	None	Navy		Feb 1966	May 1967		.550
	SH-2D	None	Navy		Mar 1971			
	SH-2F	None	Navy	Feb 1973		May 1973		.850
SH-3, Sikorsky	RH-3A	None	Navy	Apr 1964		1965	1965	
Sea King	SH-3A	HSS-2	Navy	Sep 1957	Mar 1959	Sep 1961	Mar 1966	1.282
	UH-3A	HSS-2Z	Navy			1962	1962	
	HH-3A	None	Navy					
	VH-3A	None	Army/Navy					
	CH-3B	None	AF			1962	1962	
	CH-3C	None	AF	Feb 1963	Jun 1963	Dec 1963	1965	722
	SH-3D	None	Navy			Jun 1966		1.3
	HH-3C	None	AF					1.330
	CH-3E	None	AF					.825
	HH-3E	None	AF			1965	1970	1.023
	HH-3F	None	CG			Jun 1969		
	SH-3H	None	Navy					
OH-6, Hughes Cayuse		YHO-6	Army	1961	Feb 1963	Jun 1966		

TABLE A.54 (CONT.)

DESIGNATION	MODEL DESIGNATION CURRENT	MODEL DESIGNATION FORMER	SERVICE	FIRST CONTRACT	FIRST FLIGHT	FIRST DELIVERY	END PRODUCTION	FLYAWAY COST (MILLIONS)
Helicopter Series (cont'd)								
OH-6, Hughes	OH-6A	HO-6	Army	May 1965	Apr 1966	Sep 1966	1970	.113
Cayuse (cont'd)	OH-6C	None	Army					
	OH-6D	None	Army					
OH-13, Bell		YR-13	Navy/AF	Jun 1946	Mar 1946	Feb 1947		
	OH-13E	H-13E	Army	1950	1951	1952		.035
	OH-13G	H-13G	Army	Dec 1952	May 1953	Jun 1953	Jun 1954	.047
	OH-13H	H-13H	Army	Jun 1955	Jun 1956	Dec 1956	1966	.047
	OH-13K	H-13K	Army					
	TH-13M	HTL-6	Navy	1954		1955		
	TH-13N	HTL-7	Navy	Sep 1956		Jan 1957	Dec 1958	
	UH-13P	HUL-1	Navy	Feb 1955		Nov 1955	Dec 1956	
	HH-13Q	HUL-1G	CG			1957		
	OH-13S	None	Army	Jan 1963			1971	
	TH-13T	None	Army	Jun 1964		Jan 1965	1969	
UH-19, Sikorsky	UH-19A	H-19A	AF	1948	Nov 1949			.267
Chickasaw	UH-19B	SH-19B	AF					
	UH-19C	H-19C	Army	1952	Jun 1952	Jun 1952	Dec 1952	.137
	UH-19D	H-19D	Army		Jul 1953	Jul 1953	1959	
	CH-19E	HRS-3	Navy	Feb 1951		Feb 1955	Apr 1957	
CH-21, Boeing-Vertol		H-21A	AF	Jun 1950	Mar 1952			
(Vertol) Workhorse	CH-21B	H-21B	AF		Oct 1953			.405
Shawnee	HH-21B	SH-21B	AF					
	CH-21C	H-21C	AF		Jun 1953			.251
	CH-21C	H-21C	Army					.223
OH-23, Fairchild (Hiller)		H-23A	Army				Nov 1952	
Raven	OH-23B	H-23B	Army	Jun 1950	Sep 1951	Mar 1952	May 1956	.041
	OH-23C	H-23C	Army	Dec 1954		Dec 1955	Dec 1957	.046
	OH-23D	H-23D	Army	Sep 1956	Oct 1956	Dec 1957	Dec 1961	.057
	OH-23F	H-23F	Army	Jan 1962			Jun 1962	.067
	OH-23G	None	Army			Apr 1963	1965	.032
X-25, Bensen	X-25A	None	AF		May 1968			
	X-25B	None	AF		May 1968			
CH-34, Sikorsky		HSS-1	Navy	Jun 1952	Feb 1954	Aug 1955		
Choctaw	CH-34C	H-34C	Army					
Seabat	VH-34C	None	Army					
Seahorse	LH-34D	HUS-1L	Navy			1957		
	UH-34D	HUS-1	Navy	May 1956	Mar 1957	Jan 1957	Dec 1963	.414

TABLE A.54 (CONT.)

DESIGNATION	MODEL DESIGNATION CURRENT	FORMER	SERVICE	FIRST CONTRACT	FIRST FLIGHT	FIRST DELIVERY	END PRODUCTION	FLYAWAY COST (MILLIONS)
Helicopter Series (cont'd)								
CH-34, Sikorsky Seahorse (cont'd)	VH-34D	HUS-12	Navy	May 1956		May 1959	Oct 1959	
	UH-34G	HUS-1A	Navy	May 1956		Mar 1957	Sep 1958	1.931
	HH-34J	None	AF					
	SH-34J	HSS-1N	Navy	Sep 1954		Jun 1958	Jul 1961	.344
	UH-34J	None	Navy					
CH-37, Sikorsky Mojave	CH-37A	H-37A	Army	Oct 1955	May 1956	Sep 1956	Jun 1960	.893
	CH-37B	H-37B	Army					.606
	CH-37C	HR2S-1	Navy	May 1951	Oct 1953	Oct 1953	Feb 1959	1.187
HH-43, Kaman Huskie		HTK-1	Navy	Sep 1959	Nov 1951	Nov 1951	Oct 1953	
	HH-43B	Same	AF	Jan 1958	Dec 1958	Jun 1959	1965	.437
	UH-43C	HUK-1	Navy			1958	1958	
	OH-43D	HOK-1	Navy	Jun 1950	Apr 1953	Feb 1956	Dec 1957	.345
	HH-43F	Same	AF	Dec 1961	Aug 1964		1968	.339
CH-46, Boeing-Vertol (Vertol) Sea Knight		YHC-1A	Army	Jul 1958	Aug 1959			
	CH-46A	HRB-1	Navy	Feb 1961	Oct 1962	Nov 1964	1966	.791
	RH-46A	None	Navy					
	UH-46A	None	Navy			Jul 1964	Dec 1964	
	CH-46D	None	Navy			Sep 1966	1969	.746
	UH-46D	None	Navy			Sep 1966	1968	
	CH-46E	None	Navy			Sep 1966		
	CH-46F	None				1969	1971	
CH-47, Boeing-Vertol (Vertol) Chinook		YHC-1B	Army	Jun 1959	Apr 1961			
	CH-47A	HC-1B	Army	1960	Sep 1961	Dec 1962	1967	1.395
	CH-47B	None	Army		Oct 1966	May 1967	1968	
	CH-47C	None	Army		Oct 1967	Mar 1968		3.1
HH-52, Sikorsky	HH-52A	None	CG			Jan 1963	1965	
CH-53, Sikorsky Sea Stallion	CH-53A	HH1X	Navy	Aug 1962	Oct 1964	Sep 1966	1969	1.875
	HH-53B	None	AF	Sep 1966	Apr 1967	May 1967	1967	
	RH-53B	None	Navy					
	CH-53C	None	Navy				1970	
	CH-53E	YCH-53E	Navy		Mar 1974	Jun 1977		10.3
	HH-53C	None	AF			Aug 1968	1971	
	RH-53D	None	Navy			Oct 1972	Dec 1973	2.8
	VH-53D	None	Navy					
CH-54, Sikorsky		S-64A			May 1962		1963	

TABLE A.54 (CONT.)

DESIGNATION	MODEL DESIGNATION CURRENT	MODEL DESIGNATION FORMER	SERVICE	FIRST CONTRACT	FIRST FLIGHT	FIRST DELIVERY	END PRODUCTION	FLYAWAY COST (MILLIONS)
Helicopter Series (cont'd)								
Taphe		YCH-54A	Army	May 1963		Jul 1964		
	CH-54A	Same	Army	Apr 1966		Nov 1966		
	CH-54C	None	Army				1971	
TH-55, Hughes		YHO-2	Army					
Osage	TH-55A	None	Army	Nov 1964		Oct 1964	1969	.034
AH-56, Lockheed		YAH-56A	Army	Apr 1966	Sep 1967		Jun 1968	
Cheyenne	AH-56A	None	Army				Aug 1972	2.7
TH-57, Bell	TH-57A	None	Navy	Jan 1968		Oct 1968	1968	
OH-58, Bell		OH-4A	Army		Dec 1962			
	OH-58A	None	Army	Mar 1968		May 1969		.118
AH-64, Hughes	AH-64	YAH-64	Army	Jun 1973	Sep 1975	Jun 1982		3.6
UH-60, Sikorsky	UH-60	YUH-60	Army	Aug 1972	Nov 1974	Aug 1977		2.9

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Connecticut: DMS, INC,), 1977.

TABLE A.55
COMMERCIAL HELICOPTER INVENTORY FORECAST BY MANUFACTURER AND MODEL, 1977-86

MANUFACTURER	Unit Price (000's $)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Bell												
204	$350	1	1	1	1	1	1	1	1	1	1	1
206	185	11	11	11	11	11	10	10	10	10	10	10
212	900	5	5	5	5	5	5	5	5	5	5	5
47	65	2	2	2	2	2	2	2	2	2	2	2
Fuji-Bell												
204B	600	2	2	2	2	2	2	2	1	1	1	1
Kawasaki												
KH-4	35	12	12	12	12	12	12	11	10	10	10	10
Kawasaki												
47G	35	6	6	6	4	4	2	2	0	0	0	0
Total		39	39	39	37	37	34	33	29	29	29	29

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.56
DMS FORECAST OF TOTAL MILITARY HELICOPTER DEMAND BY TYPE AND DEGREE OF COMMITMENT, 1977-86

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
1. Total Committed Users	85	128	156	141	52	118	80	66	66	80	972
2. Total Projected Users	-	10	32	36	28	28	36	36	12	-	218
3. Total Future Requirements	-	-	-	-	-	48	56	108	36	36	284
Total Attack Helicopter Market (1+2+3)	85	138	188	177	80	194	172	210	114	116	1,474
LIGHT											
1. Total Committed Users	202	169	71	34	15	-	-	-	-	-	491
2. Total Projected Users	-	6	6	18	6	-	-	-	-	-	36
3. Total Future Requirements	-	61	96	118	156	140	116	140	122	153	1,102
Total Light Helicopter Market (1+2+3)	202	236	173	170	177	140	116	140	122	153	1,629
MEDIUM											
1. Total Committed Users	499	381	351	336	149	258	219	196	180	-	2,669
2. Total Projected Users	-	47	71	24	54	46	62	66	52	54	476
3. Total Future Requirements	-	26	58	108	162	189	214	205	183	118	1,263
Total Medium Helicopter Market (1+2+3)	499	454	480	468	465	493	495	467	415	172	4,408
HEAVY											
1. Total Committed Users	57	29	40	14	14	14	-	-	-	-	168
2. Total Projected Users	-	-	4	2	6	-	-	-	-	-	12
3. Total Future Requirements	-	6	-	1	1	-	12	12	-	-	32
Total Heavy Helicopter Market (1+2+3)	57	35	44	17	21	14	12	12	-	-	212
TOTAL											
1. Total Committed Users	843	707	618	525	330	390	299	262	246	80	4,300
2. Total Projected Users	-	63	113	80	94	74	98	102	64	54	742
3. Total Future Requirements	-	93	154	227	319	377	398	465	341	307	2,681
TOTAL	843	863	885	832	743	841	795	829	651	441	7,723

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.57
DMS WORLD FORECAST OF COMMITTED MILITARY HELICOPTER USERS, BY TYPE, 1977-86

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
Total Committed Users	85	128	156	141	52	118	80	66	66	80	972
LIGHT											
Total Committed Users	202	169	71	34	15	-	-	-	-	-	491
MEDIUM											
Total Committed Users	499	381	351	336	249	258	219	196	180	-	2,669
HEAVY											
Total Committed Users	57	29	40	14	14	14	-	-	-	-	168
TOTAL											
Total Committed Users	843	707	618	525	330	390	299	262	246	80	4,300

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
Total Projected Users	-	10	32	36	28	28	36	36	12	-	218
LIGHT											
Total Projected Users	-	6	6	18	6	-	-	-	-	-	36
MEDIUM											
Total Projected Users	-	47	71	24	54	46	62	66	52	54	476
HEAVY											
Total Projected Users	-	-	4	2	6	-	-	-	-	-	12
TOTAL											
Total Projected Users	-	63	113	80	94	74	98	102	64	54	742

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
Total Future Requirements	-	-	-	-	-	48	56	108	36	36	284
LIGHT											
Total Future Requirements	-	61	96	118	156	140	116	140	122	153	1,102
MEDIUM											
Total Future Requirements	-	26	58	108	162	189	214	205	183	118	1,263
HEAVY											
Total Future Requirements	-	6	-	1	1	-	12	12	-	-	32
TOTAL											
Total Future Requirements	-	93	154	227	319	377	398	765	341	307	2,681

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.58
DMS WORLD FORECAST OF PROJECTED AND FUTURE MILITARY HELICOPTER REQUIREMENTS BY TYPE, 1977-86

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
Total Projected & Future Req.	-	10	32	36	28	76	92	144	48	36	502
LIGHT											
Total Projected & Future Req.	-	67	102	136	162	140	116	140	122	153	1,138
MEDIUM											
Total Projected & Future Req.	-	73	129	132	216	235	276	271	235	172	1,739
HEAVY											
Total Projected & Future Req.	-	6	4	3	7	-	12	12	-	-	44
TOTAL											
Total Projected & Future Req.	-	156	267	307	413	451	496	567	405	361	3,423

DMS FORECAST of COMMITTED and PROJECTED MILITARY HELICOPTER REQUIREMENTS by TYPE, 1977-86

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
ATTACK											
Total Committed & Projected	85	138	188	177	80	146	116	102	78	80	1,190
LIGHT											
Total Committed & Projected	202	175	77	52	21	-	-	-	-	-	527
MEDIUM											
Total Committed & Projected	499	428	422	360	303	304	281	262	232	54	3,145
HEAVY											
Total Committed & Projected	57	29	44	16	20	14	-	-	-	-	180
TOTAL											
Total Committed & Projected	843	770	731	605	424	464	397	364	310	134	5,042

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.59
DMS FORECAST OF TOTAL WORLD MILITARY HELICOPTERS BY TYPE, 1977-86
(UNITS)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
Total Attack Helicopter Market	85	138	188	177	80	194	172	210	114	116	1,474
Total Light Helicopter Market	202	236	173	170	177	140	116	140	122	153	1,629
Total Medium Helicopter Market	499	454	480	468	465	493	495	467	415	172	4,408
Total Heavy Helicopter Market	57	35	44	17	21	14	12	12	-	-	212
Total Military	843	863	885	832	743	841	795	829	651	441	7,723

Source: Defense Marketing Services, World Aircraft Forecast to 1986 (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.60
U.S. MANUFACTURERS' HELICOPTER PRODUCTION[a]
CIVIL AND MILITARY, 1960-77

(UNITS AND VALUE)

Year	Value (000's of current $) Civil	Military	Total	Year	Units Civil	Military	Total
1960	...	$ 173,000	...	1960	266	488	754
1961	...	228,000	...	1961	378	366	744
1962	...	250,000	...	1962	407	554	961
1963	...	337,000	...	1963	504	672	1,176
1964	...	356,000	...	1964	579	1,007	1,586
1965	$ 39,000	490,000	$ 529,000	1965	598	1,470	2,068
1966	40,000	749,000	789,000	1966	583	2,164	2,747
1967	43,000	962,000	1,005,000	1967	455	2,448	2,903
1968	57,000	905,000	962,000	1968	522	2,800	3,322
1969	75,000	845,000	920,000	1969	534	2,165	2,699
1970	49,000	694,000	743,000	1970	482	1,944	2,426
1971	69,000	469,000	538,000	1971	469	1,587	2,056
1972	90,000	396,000	486,000	1972	575	1,312	1,887
1973	121,000	268,000	389,000	1973	770	808	1,578
1974	189,000	206,000	395,000	1974	828	506	1,334
1975	274,000	100,000	374,000	1975	864	601	1,465
1976	305,000	410,000	715,000	1976	775	362	1,137
1977	316,000	316,000	632,000	1977	884	273	1,157
Total 1965-77	1,667,000	6,810,000	8,477,000	Total 1960-77	10,473	21,527	32,000
Total 1960-77		8,154,000					

[a]Excludes the production by foreign licensees. Value does not include the value of aircraft produced for the security assistance programs and accepted by the USAF.

Source: Aerospace Industries Association of America, Aerospace Facts and Figures (Washington, D.C.: Aerospace Industries Association), various annual issues.

TABLE A.61
U.S. MANUFACTURERS' PRODUCTION OF CIVIL HELICOPTERS FOR U.S. MARKET, 1960-77
(UNITS AND VALUE)

Value (000's of current $)				Units			
Year (1)	U.S. civil production (2)	U.S. civil exports (3)	U.S. Production of Helicopters for U.S. market[a] (2) - (3) (4)	Year (5)	U.S. civil production (6)	U.S. civil exports (7)	U.S. civil production of helicopters for U.S. market[a] (6) - (7) (8)
1960	...	7,701	...	1960	266	82	184
1961	...	6,846	...	1961	378	119	259
1962	...	8,777	...	1962	407	110	297
1963	...	9,811	...	1963	504	123	381
1964	...	14,619	...	1964	579	123	456
1965	39,000	16,214	22,786	1965	598	177	421
1966	40,000	11,544	28,456	1966	583	161	422
1967	43,000	25,205	17,795	1967	455	223	232
1968	57,000	32,955	24,045	1968	522	242	280
1969	75,000	29,131	45,869	1969	534	252	282
1970	49,000	27,597	21,403	1970	482	335	147
1971	69,000	45,703	23,297	1971	469	298	171
1972	90,000	50,272	39,728	1972	575	254	321
1973	121,000	83,321	37,679	1973	770	428	342
1974	189,000	109,627	79,373	1974	828	396	432
1975	274,000	104,646	169,354	1975	864	336	528
1976	305,000	113,351	191,649	1976	775	315	460
1977	316,000	105,507	210,493	1977	884	321	563
Total 1965-77	1,667,000	755,073	911,927	Total 1965-77	10,473	4,295	6,178
Total 1960-77		802,827		Total 1960-77			

[a]ORI estimate.

Sources: Aerospace Industries Association of America, Aerospace Facts and Figures, (Washington, D.C.: Aerospace Industries Association), various issues.

U.S. Bureau of the Census, U.S. Exports, Report FT410 (Washington, D.C.: USGPO), various December issues.

TABLE A.62
DMS FORECAST OF WORLD CIVIL HELICOPTER PRODUCTION BY MANUFACTURER, 1978-52

Manufacturer	Produced thru 1977	1978	1979	1980	1981	1982
Aerospatiale	2756[a]	513	569	554	564	N.A.
Bell	3257[a]	414	512	608	641	600
Enstrom	557	148	162	180	204	230
Hughes	3311	275	305	335	350	370
Sikorsky	0	44	84	90	96	100
Total	9881	1394	1632	1767	1855	N.A.

[a]Estimate

Source: Defense Marketing Services, Monthly Intelligence Reports: Civil Aircraft (Greenwich, Ct.: DMS, Inc.), 1977.

N.A.: Not Available

TABLE A.63
WORLD (CIVIL AND MILITARY) PRODUCTION FORECAST FOR TURBINE POWERED HELICOPTERS BY MANUFACTURER, 1977-83

Manufacturer	Total Thru 1976	1977	1978	1979	1980	1981	1982	1983	Total 1977-1983	Total Estimated Production Thru 1983	Estimated Total Value of Production 1977-1983 (millions of 1977 dollars)
Foreign											
Aerospatiale	4074	464	503	516	528	531	482	502	3526	7600	$2555.5
Agusta	36	55	75	78	78	94	96	84	560	596	468.8
MBB	313	88	108	114	132	144	136	130	852	1165	340.8
Westland	222	108	132	139	127	90	80	72	748	970	1416.3
Total Foreign	4645	715	818	847	865	859	794	788	5686	10331	4781.4
U.S.											
Bell	18087	862	813	865	830	773	725	702	5956	24043	4125.4[a]
Boeing Vertol	1579	54	48	42	36	32	18	12	242	1821	840.4
Hughes	2262	232	270	270	252	218	188	190	1620	3882	520.0
Sikorsky	1544	71	120	184	228	238	258	266	1365	2909	3996.6
Undetermined	0	-	-	4	9	12	42	72	139	139	331.0
Total U.S.	23472	1219	1251	1365	1355	1273	1231	1242	9322	32794	9813.4
Total World	28117	1934	2069	2212	2220	2132	2025	2030	15008	43125	14594.8

[a]No dollar estimate is included here for modernizing the AH-1G although they are included in the units total.

NOTE: Data includes production by foreign licensees.

Source: Forecast Associates, Inc., World Helicopter Market Through 1983 (Ridgefield, Ct.: Forecast Associates, Inc.), 1977.

TABLE A.64
WORLDWIDE MILITARY INVENTORY FORECAST BY MANUFACTURER, 1977-86
(UNITS)

MANUFACTURER	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Foreign											
Aerospatiale	2366	2453	2495	2533	2519	2430	2322	2205	2099	1979	1918
Agusta	1261	1339	1412	1491	1506	1484	1412	1361	1342	1316	1287
MBB	39	42	42	64	122	183	245	358	468	568	600
Westland	804	796	788	739	782	799	777	755	687	611	602
Subtotal Foreign Manufacturers	4470	4630	4737	4827	4929	4896	4756	4679	4596	4474	4407
U.S.											
Bell	8782	8990	9124	9131	9211	9201	9182	9090	9010	9001	8977
Boeing Vertol	886	902	900	987	889	880	877	796	719	643	616
Fairchild	68	58	51	42	33	24	13	0	0	0	0
Hughes	1215	1212	1193	1205	1226	1207	1203	1214	1186	1190	1202
Kaman	139	136	133	132	124	116	108	100	94	86	86
Sikorsky	1122	1109	1140	1162	1318	1503	1693	1863	2030	2185	2177
Subtotal U.S. Manufacturers	12212	12407	12541	12659	12801	12931	13076	13063	13039	13105	13058
Other											
CAC	32	30	36	45	52	52	52	50	50	50	50
Dornier	293	293	292	288	288	288	284	274	246	221	220
Fuji	149	159	162	165	165	165	164	164	164	163	163
Hindustan	241	258	285	300	296	295	292	290	278	278	272
Kamov	11	11	10	10	9	9	8	7	7	7	6
Kawasaki	278	278	283	288	294	287	281	276	271	266	263
Meridionali	90	90	86	86	86	76	76	50	30	20	0
Mil	524	507	494	472	450	420	385	340	290	254	225
Mitsubishi	78	79	84	93	101	99	97	95	93	91	87
PADC	0	0	0	6	18	33	33	33	33	33	33

TABLE A.64 (CONT.)

		FORECAST									
		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RACA	5	8	8	27	38	38	38	38	35	33	33
Taiwan Bell	104	118	117	116	115	114	113	112	111	110	109
VFW	108	108	106	106	102	100	96	90	86	82	82
Yugoslavian Government	57	107	127	132	132	132	132	130	129	128	128
Subtotal other	1970	2046	2090	2134	2146	2108	2064	1949	1823	1736	1671
Undetermined	0	118	182	321	496	750	1037	1394	1767	2151	2484
TOTAL SUMMARY											
Foreign Manufactured	4470	4630	4437	4827	4929	4896	4756	4673	4596	4474	4407
U.S. Manufactured	12212	12407	12541	12659	12801	12931	13076	13063	13039	13105	13058
Unclassified (Foreign produced)	1970	2046	2090	2134	2146	2108	2064	1949	1823	1736	1671
Undetermined	0	118	182	321	496	750	1037	1394	1767	2151	2484
World Inventory Total	18652	19201	19068	19941	20372	20685	20933	21085	21225	21466	21620
U.S. Military Inventory	10124	10134	10102	10164	10399	10558	10705	10758	10776	10925	10927

Source: Defense Marketing Services, World Aircraft Forecast to 1986, (Greenwich, Ct.: DMS, Inc.), 1977.

TABLE A.65
U.S. MILITARY INVENTORY FORECAST BY MANUFACTURER AND MODEL, 1977-86
(UNITS)

MANUFACTURER	Unit Price (000's 1976$)	Actual 1976 Inventory	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Bell												
AH-1	$1,300											
Army		576	481	400	316	242	242	240	238	236	239	232
Navy		62	62	62	62	60	60	60	59	59	58	58
AH-1S	1,500											
Army		123	218	299	393	583	580	577	575	572	572	568
AH-1T	3,900											
Navy		6	8	22	45	57	57	57	56	56	56	55
HH-1	365											
USAF		29	29	29	26	26	24	20	18	10	8	0
Navy		20	19	18	16	10	4	0	0	0	0	0
OH-58	118											
Army		2048	2040	2034	2030	2020	2015	2010	2000	1995	1990	1985
TH-1	2,300											
Army		34	34	34	34	33	33	33	33	32	32	32
Navy		40	39	39	37	37	35	35	30	20	20	20
USAF		20	20	19	19	18	18	16	16	12	11	10
TH-57	117											
Navy		36	36	35	35	34	34	32	30	28	26	26
UH-1	715											
Army		492	492	490	489	488	487	485	483	480	480	475
Navy		79	78	77	76	74	74	73	72	72	70	68
USAF		36	36	35	35	34	34	34	30	28	28	28
UH-1H	715											
Army		3565	3563	3562	3560	3558	3556	3552	3500	3460	3460	3450
UH-1N	1,730											
Navy		160	181	193	193	192	192	191	191	190	190	188
USAF		75	75	72	68	68	68	67	67	67	66	64
BELL TOTAL		7401	7411	7386	7434	7534	7513	7482	7398	7317	7306	7259

TABLE A.65 (CONT.)

Boeing Vertol												
ACH-47 Army	$2,100	4	4	4	3	3	3	3	2	2	2	1
CH-46 Navy	790	347	347	346	346	342	340	338	269	200	130	110
CH-47 Army	3,100	247	246	245	244	243	240	240	238	236	234	230
CH-47C Army	3,100	204	213	213	213	213	212	212	212	211	211	210
UH-46 Navy	790	16	16	15	15	14	14	14	10	5	5	5
Boeing Vertol Total		818	826	823	821	815	809	807	731	654	582	556
Hughes												
AH-64A Army	3,600	0	0	0	0	0	0	0	16	30	78	126
OH-6 Army	113	419	415	411	407	403	400	396	392	388	384	380
TH-55 Army	35	607	600	590	588	580	560	540	530	500	468	440
Hughes Total		1026	1015	1001	995	983	960	936	938	918	930	946
Kaman												
SH-2 Navy	850	94	94	93	93	92	92	90	86	84	82	82

TABLE A.65 (CONT.)

MANUFACTURER	Unit Price (000's $)	Base 1976	FORECAST 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Sikorsky												
CH-3	$ 825											
USAF		49	49	49	49	49	48	48	48	48	46	42
CH-53	2,500											
Navy		196	195	194	194	190	190	186	186	184	180	178
USAF		10	10	10	10	10	10	9	9	9	9	9
CH-53E	10,300											
Navy		3	6	9	9	19	33	47	51	70	70	70
CH-53G	2,500											
USAF		8	10	12	12	12	12	12	12	12	11	11
CH-54	2,105											
Army		73	73	73	72	72	71	71	70	70	70	69
HH-3	1,000											
Navy		12	12	11	11	10	9	8	6	6	4	0
USAF		38	38	37	37	36	36	36	36	34	32	32
USCG		38	37	37	37	36	36	36	34	34	32	32
HH-52	215											
USCG		67	67	64	64	63	63	60	55	50	45	45
HH-53	4,700											
USAF		41	41	39	39	39	38	38	38	38	37	37
RH-3	2,800											
Navy		8	8	8	8	7	7	7	7	6	6	6
RH-53	2,800											
Navy		27	27	27	26	26	26	25	25	24	23	23
SH-3	1,300											
Navy		205	205	204	204	202	200	200	198	196	194	192
UH-60A	2,900											
Army		0	0	15	39	195	375	555	734	910	1090	1100
VH-3	1,300	10	10	10	10	9	9	9	9	8	8	8
Sikorsky Total		785	788	799	821	975	1163	1347	1528	1699	1857	1854
Undetermined Light Helo	NA											
Army		0	0	0	0	0	0	0	0	24	88	152
Undetermined Medium Helo	NA											
USAF		0	0	0	0	0	16	28	52	52	52	50
USCG		0	0	0	0	0	5	15	25	28	28	28
Undetermined Medium Total		0	0	0	0	0	21	43	77	80	80	78

TABLE A.65 (CONT.)

SUMMARY: US MILITARY INVENTORY

Bell	7401	7411	7386	7434	7534	7513	7482	7398	7317	7306	7259
Boeing Vertol	818	826	823	821	815	809	807	731	654	582	556
Hughes	1,026	1015	1001	995	983	960	936	938	918	930	946
Kaman	94	94	93	93	92	92	90	86	84	82	82
Sikorsky	785	788	799	821	975	1163	1347	1528	1699	1857	1854
Subtotal	10,124	10134	10102	10164	10399	10537	10662	10681	10672	10757	10697
Undetermined Total	0	0	0	0	0	21	43	77	104	168	230
U.S. MILITARY TOTAL	10,124	10,134	10,102	10,164	10,399	10,558	10,705	10,758	10,776	10,925	10,927

NA: Not available

Source: Defense Marketing Services, World Aircraft Forecast to 1986, (Greenwich, Ct.: DMS, Inc.), 1977.

APPENDIX B

AVIATION DATA BASE MEMO

Operations Research, Inc.

MEMORANDUM

June 17, 1976

TO: R. Rollins

FROM: L. Kaplan

SUBJECT: Aviation Data Base Development and Application - Commercial Aircraft and Engine Shipments, U.S. and Worldwide.

This memorandum presents an example of the potential utility of the Aviation Data Base to OAST analysts. Basically, the system can be used to store data which is considered valuable for analysis of OAST programs. On-line data allows rapid access to reliable information, therefore, reducing time spent on research and providing data for quick reaction tasks.

The way in which this system can be used was illustrated in a previous memorandum (May 26, 1976 Progress Report) where the demand for agricultural aviation was projected through the year 2000. The necessary data was entered into the Aviation Data Base and is now available for future analysis. Another example has been developed to further demonstrate the utility of the system.

On June 11, 1976, ORI prepared a report for NASA Headquarters on worldwide and U.S. shipments of commercial aircraft for NASA's budget advocacy package. Both past data and future projections were provided. Most of this data was compiled by hand from government and industrial sources. None of the necessary data was in the Aviation Data Base or the GEMAP Data Bases. Had the Aviation Data Base been operative at that time, as it is now, that analysis could have been done in a fraction of the time it did take.

In the report the data was separately grouped by: 1) commercial transports, 2) general aviation aircraft, both fixed wing and helicopters and 3) aircraft engines. The data was further developed by ORI for entrance into the data base. The three groupings were changed into eight variables (see Table 1), four for U.S. manufacturers and four for worldwide shipments. All eight variables were entered into the economic data file of the Aviation Data Base. Each variable covers two ten year periods, 1966 - 1974 and 1975 - 1986. The first period contains actuals and the second projected data. All dollars are stated in 1975 constant dollars.

The new variables were entered into the Aviation Data Base via the update program (see May 26, 1976 Progress Report) which prints out a complete description of each variable, including the source, time span, type and frequency of the data. Hardcopied descriptions for each variable are provided in Figures 1 - 8. Graphic plots of the variables are presented in Figures 9 - 12.

Calculations were made with the system to determine total U.S. manufacturers aircraft shipments and total worldwide aircraft shipments for each year. This was done by simply adding together the four variables associated with each respective total. Figure 13 presents a graphic plot in time series format of the resulting calculation.

A major deficiency of the current system was uncovered when entering the new variables. The update program allows the user to enter sources and descriptions of the variables, however, only two lines of characters may be entered. Thus detailed descriptions and numerous sources cannot be entered into the descriptive listing. This problem should be corrected in order to attain maximum utility from the system.

TABLE 1

AVIATION DATA BASE

VARIABLES FOR COMMERCIAL AIRCRAFT

AND ENGINE SHIPMENTS U.S. AND WORLDWIDE

VARIABLE NAME	VARIABLE DESCRIPTION
ECGA0044	Commercial Transport Aircraft U.S. Manufacturers' Shipments
ECFA0010	Commercial Transport Aircraft Worldwide Shipments
ECGA0045	Civil General Aviation Fixed Wing Aircraft U.S. Manufacturers' Shipments
ECFA0011	Civil General Aviation Fixed Wing Aircraft Worldwide Shipments
ECGA0046	Commercial Helicopters U.S. Manufacturers' Shipments
ECFA0012	Commercial Helicopters Worldwide Shipments
ECGA0047	Commercial Aircraft Engines U.S. Manufacturers' Shipments
ECFA0013	Commercial Aircraft Engines Worldwide Shipments

CURRENT DATE: 06/16/78

VARIABLE NAME: EOGA0044

FILE LOCATION: ECDF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM TRANSPORT AIRCRAFT US MFG SHIPMENTS

SOURCE: 1966-73-FAA STATISTICAL HANDBOOK 1974 AEROSPACE F&F
1975/76 1975-EST, 1978-85-BOEING TO SUBCOMMITTEE
ON AVIATION AND TRANS R&D76

DATE: 760616 FREQ WHEN ESTIMATES ARE REVISED TIME SPAN: 1966-8

DESCRIPTION: COMMERCIAL TRANSPORT AIRCRAFT U.S. MANUFACTUERS
SHIPMENTS-ACTUAL (1966-1974) AND PROJECTED (1975-1985)

FIGURE 1

CURRENT DATE: 06/16/76

VARIABLE NAME: ECFA0010

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM TRANSPORT AIRCRAFT WORLD SHIPMENTS

SOURCE: PRESENTATION BY BOEING TO SUBCOMMITTEE ON AVIATION AND TRANS R&D 1976

DATE: 760616 FREQ: WHEN ESTIMATES ARE REVISED TIME SPAN: 1966-8

DESCRIPTION: COMMERCIAL TRANSPORT AIRCRAFT WORLDWIDE SHIPMENTS-ACTUAL (1966-1974) AND PROJECTED (1975-1985)

FIGURE 2

CURRENT DATE: 06/16/76

VARIABLE NAME: EOGA0045

FILE LOCATION: ECDF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: CIVIL GEN AVIATION F-W AIRCRAFT US MFG SHIPMENTS

SOURCE: GENERAL AVILATION MANUFACTURERS ASSOCIATION AND ORI

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN: 1966-89

KEYWORDS: FIXED WING

DESCRIPTION: CIVIL GENERAL AVIATION FIXED WING AIRCRAFT U.S. MANUFACTURERS SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1976-85) PROJECTIONS BY ORI FROM GAMA DATA

FIGURE 3

CURRENT DATE: 06/16/76

VARIABLE NAME: ECFA0011

FILE LOCATION: EDDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: CIVIL GEN AVIATION F-W AIRCRAFT WORLD SHIPMENTS

SOURCE: DEVELOPED BY ORI FROM AVIATION DATA SYSTEMS INC REPORT ON NON-U.S. MFG WHICH SHOWS AIRCRAFT SHIPMENTS TO BE 9.3 PERCENT OF THE WORLDWIDE TOTAL

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN: 1966-85

KEYWORDS: FIXED WING

DESCRIPTION: CIVIL GENERAL AVIATION FIXED WING AIRCRAFT WORLDWIDE SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1976-85)

FIGURE 4

CURRENT DATE: 06/16/76

VARIABLE NAME: EOGA0045

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM HELICOPTERS US MFG SHIPMENTS

SOURCE: AEROSPACE F & F AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA INDUSTRIAL OUTLOOK

DATE: 750515 FREQ. WHEN EST ARE REVISED TIME SPAN: 1966-85

DESCRIPTION: COMMERCIAL HELICOPTERS U.S. MANUFACTURERS SHIPMENTS-ACTUAL (1966-1974) AND PROJECTED (1975-85)

FIGURE 5

CURRENT DATE: 06/16/76

VARIABLE NAME: ECFA0012

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM HELICOPTERS WORLD SHIPMENTS

SOURCE: DEVELOPED BY ORI FROM U.S. DATA ASSUMES U.S. RETAINS ITS CURRENT MARKET SHARE OF 80.6 PERCENT OF THE WORLD MARKET-COMMISSION OF EUROPEAN COMMUNITIES

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN: 1966-85

DESCRIPTION: COMMERCIAL HELICOPTERS WORLDWIDE SHIPMENTS-ACTUAL (1966-74) AND PROJECTED (1975-85)

FIGURE 6

CURRENT DATE: 06/16/75

VARIABLE NAME: ECGA0047

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM AIRCRAFT ENGINES US MFG SHIPMENTS

SOURCE: 1966-75-U.S. INDUSTRIAL OUTLOOK 1974 75 76 DOC 1975-85-FAA PROJECTIONS IN THEIR AVIATION FORECASTS FY 1967-87

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN: 1966-85

DESCRIPTION: COMMERCIAL AIRCRAFT ENGINES U.S. MANUFACTURERS SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1975-85)

FIGURE 7

CURRENT DATE: 06/16/76

VARIABLE NAME: ECFA0013

FILE LOCATIION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM AIRCRAFT ENGINES WORLD SHIPMENTS

SOURCE: DEVELOPED BY ORI ASSUMES U.S. PRODUCTION IS 90 PERCENT OF WORLD MARKET-THE CHALLENGE OF FOREIGN COMPETITION AIAA NOV. 1975

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN: 1966-85

DESCRIPTION: COMMERCIAL AIRCRAFT ENGINES WORLDWIDE SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1976-85)

FIGURE 8